Undergraduate Research Opportunities Program

Proceedings

2015-16

香港科技大學
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

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* Abstracts from each School are listed first by alphabetical order of Department code, and then by alphabetical order of Advisor's surname.

Summary of UROP Courses

UROP 1000	Undergraduate Research Opportunities Program *(0 credit with stipend option, offered in summer session only)*
UROP 1100	Undergraduate Research Opportunities Program Series 1 *(1 credit, offered throughout the year)*
UROP 2100	Undergraduate Research Opportunities Program Series 2 *(1 credit, offered throughout the year; prerequisite is pass in UROP1100, with approval by project advisor)*
UROP 3100	Undergraduate Research Opportunities Program Series 3 *(1 credit, offered throughout the year; prerequisite is pass in UROP2100, with approval by project advisor)*
UROP 4100	Undergraduate Research Opportunities Program Series 4 *(1 credit, offered throughout the year; prerequisite is pass in UROP3100, with approval by project advisor)*

Message from the President

As a research-focused university, we have established ourselves in just two decades and risen fast through pioneering research breakthroughs. The Undergraduate Research Opportunities Program (UROP) has long been supporting the university's educational framework by offering unique research learning experience to undergraduate students in the early years of their academic life.

Since its launch in 2005, UROP has gained recognition from our faculty members as well as undergraduate students. In the 2015–2016 academic year, approximately 150 faculty members have offered over 300 research projects, and nearly 400 students have conducted research in their areas of interest. We value the importance of knowledge transfer and production from our students at their first stage of tertiary education. Through UROP, students can apply their solid academic knowledge by learning from our renowned researchers. Moreover, participants are granted the opportunities to utilize the most advanced resources that were typically accessible only to postgraduate students in the past. Under the guidance of corresponding faculty supervisors, I am proud to see our undergraduate students are committed to research across different disciplines with critical thinking, open-mindedness and a can-do attitude, and their endeavors and hard work are summarized through these proceedings.

I would like to take this opportunity to express my sincere gratitude to the contribution of our faculty members for shouldering additional responsibilities with dedicated efforts. With the encouraging achievements, I ask for your continued support and participation in UROP to promote and cultivate the research culture among the HKUST community. Join us with this innovative spirit to uphold HKUST's reputation as a source of first-rate academic research!

Sincerely,

Tony F Chan

President

HKUST

UROP Overview 2015–16

In the 2015–16 academic year, the Undergraduate Research Opportunities Program (UROP) continued to gain significant attention on the Clear Water Bay campus. Approximately 30% of the university's faculty members have contributed to the program by offering over 300 projects this year, and nearly 400 undergraduate students have enrolled to UROP to kick start their journey as a researcher. Of the many students who have joined the program since its establishment, about one-third have pursued postgraduate studies, either locally in Hong Kong or in leading overseas higher education institutions after graduation. These motivating figures show that UROP is an excellent platform for our undergraduate students to take academic research as a potential career, as well as to commit to advancing knowledge within our university.

2016 Mr. Armin and Mrs. Lilian Kitchell Undergraduate Research Award and UROP Faculty Research Award

The **Mr. Armin and Mrs. Lilian Kitchell Undergraduate Research Award** is exclusively awarded to UROP participants in HKUST starting from 2010. The Award aims to encourage promising UROP students with outstanding academic strength and potential to continue their journey in research. In 2016, UROP supervisors nominated 20 of their students, among whom 10 candidates were shortlisted and invited to provide a final presentation on their research findings to the UROP Advisory Board (composed of seven members across different schools). After a comprehensive and careful selection process, 6 awardees were announced at the **UROP Award Presentation Ceremony** held on April 18, 2016. We also embraced the second year of the **UROP Faculty Research Award**, which was presented to the supervising team of each student awardee for their dedicated efforts in mentoring these students. All finalists' research posters were exhibited at the Academic Concourse at HKUST during the **UROP Week 2016** (April 18 to 22, 2016).

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SCHOOL OF SCIENCE

Department of Chemistry

Modeling Protein-ligand Interactions Using Docking and Other Computational Tools

Advisor: HUANG Xuhui / CHEM
Student: CHUA Wan Zhen / SSCI UROP Course: UROP1100, Summer 2016

The DNA glycoslase AlkD is a DNA repair enzyme, with a unique mechanism: It recognizes abnormal base pairs by interacting with the phosphoribose backbone rather than directly interacting with mutated base pairs. The main purpose of this project is to determine the dynamics of protein diffusion along the DNA molecule and its implication in the search for a target mutated DNA sequence. Determining the accurate mechanism of action of AlkD is highly essential for ensuring a highly efficient and rapid protein–DNA association.

Advisor: HUANG Xuhui / CHEM
Student: LI Han / BCB UROP Course: UROP1100, Summer 2016

Molecular dynamics (MD) simulation, a molecular modeling approach performed by solving Newton's equations, is useful for simulating time-related microscopic events. This report reviews the general principles and some technical details of MD simulation by describing the rundown on the basis of a commonly used software, GROMACS.

Development of Organocatalytic Reactions

Advisor: SUN Jianwei / CHEM
Student: CHEUNG Man Hong Andy / SSCI-IRE UROP Course: UROP1100, Summer 2016

In this study, the addition of indole derivatives and other nucleophiles to a tertiary or quaternary propargylic alcohol was investigated. Different propargylic alcohols and nucleophiles were allowed to react, with a Brønsted acid (BINOL-NTf) as a catalyst. The effects of the substituents on reaction time and yield were studied. The results demonstrated that indoles substituted with EDGs or EWGs can react with propargylic alcohol. Furthermore, strong EDGs attached to an indole can accelerate the reaction and improve product purity. Alkyl groups on propargylic alcohols had very little effect on the reaction. In addition, thioacetic acid is a potential sulfur source for propargylic alcohols. Thus, strong EDGs can be attached to indole before the nucleophilic attack of indoles on propargylic alcohols during total synthesis of indole-containing compounds.

Design and Synthesis of Functional Aggregation-Induced Emission Luminogens and Their Biological Applications

Advisor: TANG Benzhong / CHEM
Student: PARK Hojeong / BCB UROP Course: UROP1100, Fall 2015
UROP2100, Spring 2016

In cell biology, the importance of fluorescent dyes has increased because they facilitate the visualization of morphological changes in specific organelles. To study the morphology of specific organelles, specific and photostable fluorescent probes are required. In this study, a cell membrane-targeting dye with aggregation-induced emission (AIE) characteristics, namely AS2CP-TPA, was synthesized by linking methylpyridinium hexafluorophosphate with a donor–acceptor-type fluorescent dye. The extended electronic conjugation results in a longer absorption wavelength and higher molar absorptivity. Its nanoaggregates exhibited AIE characteristic, bright red emission, high fluorescence quantum efficiency, high bio-compatibility, and high resistance to photo-blenching. These highly remarkable attributes render this probe a promising long-term cell tracer and a great tool for detecting long-term morphological changes in the cell membrane.

Advisor: TANG Benzhong / CHEM
Student: DENG Weisi / CHEM UROP Course: UROP1100, Summer 2016

Self-healing polymers have attracted great attention from scientists because their useful lifespan automatically extends, improving the reliability of the mechanical component and preventing the unnecessary waste of resources. Although the healing process can be accomplished without manual intervention, the flaws in these materials should be identified to minimize the negative effects of material degradation during further modification in future design and fabrication. Herein, we review some reported discovery in the field of self-healing polymers as well as explore the possibility of combining aggregation-induced emission (AIE) and self-healing polymers on the basis of dynamic-covalent boroxine bonds. By using these cross-linkers, fractures in TPE rotors can be easily located by simply observing color change caused by concentration change.

Development of Fluorescent Bio-probes with Aggregation-induced Emission Characteristic

Advisor: TANG Benzhong / CHEM
Student: CHAK Man Him / SSCI-IRE UROP Course: UROP1000, Summer 2016

Photodynamic therapy (PDT) uses light, photosensitizers, and oxygen to kill living cells; it is a noninvasive therapy used to treat various diseases, such as cancer. When the light of a specific wavelength is shone on photosensitizer-containing tissues, the photosensitizers are activated and convert nearby oxygen molecules to active singlet oxygen molecules, which can kill surrounding cells. This therapy can be focused on the specific area of irradiation, thus reducing side effects. However, the most commonly used photosensitizer porphyrin is typically hydrophobic and aggregates under an aqueous environment and they often suffer from Aggregation Caused Quenching (ACQ) effect, thus reducing the efficiency of photodynamic therapy. Therefore, in this project, we aim to synthesize a porphyrin derivative with aggregation-induced emission (AIE) characteristic for better PDT effect.

Advisor: TANG Benzhong / CHEM
Student: LEUNG Ziuwin / SSCI UROP Course: UROP1000, Summer 2016

The use of red/near-infrared (NIR) fluorescent molecules is preferred over that of shorter wavelength fluorescent molecules because they aid in avoiding spectral overlap with biological autofluorescence, thus enabling the understanding of biological and chemical reactions along with the related cellular pathways through bioimaging. Here, we report the synthesis and characterization of a new donor–acceptor (D-A)-type compound, TPE-T(NO2). Its molecular structure was characterized through ^{1}H-NMR, ^{13}C-NMR, and mass spectroscopy. TPE-T(NO2) exhibits pronounced aggregation-induced emission properties with orange/red emission, along with a large Stokes shift and high emission intensity; thus, TPE-T(NO2) has promising applications in organic light-emitting diodes as well as biological imaging.

NHC-catalyzed redox amidation of alpha-beta-epoxy aldehydes

Advisor: TONG Rongbiao / CHEM
Student: LIAW Ming Wai / CHEM UROP Course: UROP1100, Spring 2016

Our research group is working on the development of a convergent synthetic route for the family of tricyclic phorbaketal and alotaketal natural products. One of the key carbon-carbon formations is to unite two fragments: carvone-derived triene chloride and a,β-hydroxy Weinreb amide. I focus on efficient preparation of the β-hydroxy Weinreb amide from commercially available L-(−)-malic acid. Thus far, we have developed a novel, efficient, and one-step synthetic method for β-hydroxy Weinreb amide from α,β-epoxyaldehyde. —This method featuring NHC-catalyzed redox reaction is unprecedented in the literature and greatly improves the efficiency of making β-hydroxy Weinreb, which is conventionally prepared by a multistep synthetic route.

Metal-organic Silica Analogs

Advisor: WILLIAMS Ian Duncan / CHEM
Student: YANG Zhibo / CHEM UROP Course: UROP1100, Spring 2016

Metal–organic framework (MOF) quartz analog is a distinct type of zeolitic imidazolate framework. This report provides an overview of MOF quartz analog research, based on a literature review and experimental results. The methodology section introduces a solvothermal synthesis method and characterization methods including SXRD, pXRD, TGA, and DSC. Among the properties of the MOF quartz analog, the main focus is on its thermal stability, structure, and phase transition. Finally, some insight on further development and application of these quartz analogs is described.

Synthesis of Polymer Materials for Organic Solar Cells

Advisor: YAN He / CHEM
Student: LEI Chin Wang / SSCI-IRE UROP Course: UROP1000, Summer 2016

Because of their strong electron-accepting ability, perylene diimide (PDI) and naphthalene diimide (NDI) are used as electron acceptors in organic solar cells (Yu Zhong, 2014). By developing NDI trimers or NDI–PDI–NDI molecules, we aim to produce novel electron acceptors with higher electric conductivity in a blended structure. Our trimer acceptors can stack up and connect with each other, thus preventing the formation of island or incomplete circuit and increasing solar cell efficiency.

Advisor: YAN He / CHEM
Student: WEN Chi Ho Ethan / SSCI-IRE UROP Course: UROP1000, Summer 2016

This report comprises two parts: The first part discusses the synthesis of these polymers, which requires three reactions in a sequence. The experimental procedures and apparatus used in the three reactions are extensively documented and a brief explanation of the reaction mechanism for each is provided. The second part describes the purification of these polymers by using two common techniques—column chromatography and Soxhlet extraction. Column chromatography was used to separate the desired polymer from a mixture of products by using the principle of differences in polarity, and Soxhlet extraction is used to remove small molecular weight polymers and achieve a more refined molecular range.

Nanomaterials for Solar Energy Conversion

Advisor: YANG Shihe / CHEM
Student: LEUNG Cheuk Wai / CHEM-IRE UROP Course: UROP1100, Spring 2016

With increasing global energy consumption and decreasing supply of fossil fuel, renewable energy is the clear solution. Because of the abundance of sunlight, solar energy-harvesting is the most promising option. Because of the rapid increase in their performance, perovskite solar cells have recently gained attention. Although these lead halide perovskite solar cells demonstrate highly favorable performance, they have several defects, particularly the unstable moisture resistance and toxicity of their lead component. Two-dimensional (2D) perovskite analogs demonstrate a relatively higher moisture resistance; this property may aid in increasing the moisture resistance of three-dimensional (3D) perovskite. To study the physical properties and nature of 2D perovskite analogs, we synthesized high-quality films of this material. Here, we summarize some background of this field of study and report the filmmaking method with toluene washing, analyzed using scanning electron microscopy and UV-vis absorption spectroscopy.

Division of Life Science

Plankton Ecology under a Changing Climate

Advisor: CHAN Kit Yu Karen / LIFS
Student: SURADJA Maria Dominika Ivana / ENVS-IRE UROP Course: UROP1100, Fall 2015
UROP2100, Spring 2016

Approximately 30% of carbon dioxide (CO_2) in the atmosphere is absorbed by the ocean, leading to ocean acidification. This process can cause decalcification in some shell-building organisms. The alkalinity anomaly technique (AAT) quantifies calcification: a reduction in total alkalinity (TA) signifies uptake of dissolved carbonate ions (CO_3^{2-}) through biological activities. While this technique has been extensively used to study calcification in corals, very few studies have applied it on other marine organisms. Here, the AAT was used to measure calcification in the snail *Crepidula onyx. C. onyx* snails were cultured in filtered seawater (FSW), FSW treated with HCl, and FSW treated with HCl and Na_2CO_3. We observed that changes in pH alone reduced growth, and that the addition of carbonate ions had a compensatory effect. We also observed in most cases, a decrease in seawater pH and TA accompanied with an increase in shell size. This relationship implied calcification occurred and that AAT is also applicable to other marine mollusks, especially to non-invasively assess calcification under future ocean conditions.

Advisor: CHAN Kit Yu Karen / LIFS
Student: CHU Siu Ki / SSCI UROP Course: UROP1000, Summer 2016

Living habitats of many marine organisms are currently encountering acidification caused by increased atmospheric CO_2 concentration. In this experiment, the response of *Crepidula onyx* larvae to this environmental change was studied by rearing them in different pH environments and sampling them to perform a series of feeding experiments. We observed that the feeding rate of *C. onyx* larvae increased when either the rearing pH or the pH of their food *Iscohrysis galbana* decreased (pH 7.7). This observed increase in feeding is likely to help this organism to cope with changes in carbonate chemistry by increasing energy provision. Further studies are needed to investigate the changing trophic interactions in the face of climate change.

Molecular Regulation of Muscle Stem Cell Quiescence by Non-coding RNAs

Advisor: CHEUNG Tom / LIFS
Student: CHAN Sze Man / BCB UROP Course: UROP1100, Fall 2015
Student: SIU Men Yi Mona / BCB UROP Course: UROP1100, Fall 2015

Postnatal myogenesis is a multistep process regulated by proteins from two transcription factor families, namely myogenic regulatory factors and myocyte enhancer factor 2. Long non-coding RNAs (LncRNAs) have been proposed to add a new level of regulation on postnatal myogenesis. Nevertheless, the regulatory role of LncRNAs in myogenesis remains largely unknown. In this study, we examined the role of *LncMyoD*, an LncRNA encoded next to *MyoD*, in myogenesis. Through immunofluorescence, we showed that *LncMyoD* knockdown results in the downregulation of myogenin (a terminal myogenic differentiation marker) but has no effects on the expression of MyoD (an early myogenic differentiation marker). Taken together, these data demonstrate that *LncMyoD* regulates myoblast differentiation but not myogenic commitment.

Advisor: CHEUNG Tom / LIFS
Student: NG Lau Yan / BIOT UROP Course: UROP1100, Spring 2016

Rbfox2, an RNA-binding protein, plays a vital role in myogenesis through its alternative splicing regulation. Knowledge regarding this protein is limited; therefore, this study investigated the roles of this novel protein throughout myogenesis, thus providing insight on the potential roles of Rbfox2 in proliferation, differentiation,

and regeneration. First, the knockdown of *Rbfox2* inhibited satellite cell proliferation but enhanced its differentiation; the differentiation-related finding disagrees with previous results that Rbfox2 is indispensable for myoblast fusion during the differentiation process. Second, the role of Rbfox2 was noted in the regeneration process, but its mechanism remains unclear. Third, high expression of nuclear Rbfox2 isoforms in regenerated and differentiating cells further emphasized the contribution of Rbfox2 in the preceding two stages.

Characterization of Suppressor Mutations that Antagonize the Body Size Control

Advisor: CHOW King Lau / LIFS
Student: TAM Ga Kei / BCB UROP Course: UROP1000, Summer 2016

Bone morphogenetic proteins (BMPs) are crucial morphogens, which induce the transcription of genes that regulate body size. The underexpression or overexpression of BMPs alters the length of *Caenorhabditis elegans*. This project focused on the differential effects of BMP signals on hypodermis and gonad volumes. BMP mutants *dbl-1* and *lon-2* were compared with the wild type animals. After microinjecting DNA constructs containing a tissue-specific promoter ligated to the GFP reporter gene, the target organ became fluorescent. When a stable transgenic line was established, the volumes of target organs could be measured under a confocal microscope. The relative volumes of the whole body and target organs were calculated. The results facilitate comprehensive understanding of tissue organ volume changes for the BMP signaling pathway.

Genetic Identification of Negative Regulator of Bone Morphogenetic Protein Signaling Pathway Negative Regulator

Advisor: CHOW King Lau / LIFS
Student: CHAN Hiu Yin / CBME UROP Course: UROP1100, Spring 2016

This project aims to study how the overproduction of the axonal guidance cue UNC-129 modulates axonal migration in *Caenorhabditis elegans* motoneurons and identify the change in the mechanism of motor axonal growth. Wild-type proteins can be produced at a level higher than normal in wild-type worms by overexpressing relevant encoding genes. The overexpression of a ligand-encoding gene may lead to morphological changes through increased specific activity of relevant proteins. Therefore, gene overexpression is a suggested strategy to study the change in motor axonal migration. Assays are designed to examine the differences between wild-type and *unc-129*-overexpressing worms on motor axons' migration rates and number of misguided axons during migration. Here, two methods are proposed to prepare overexpression plasmids differing in promoters.

Optimizing the Gene Inactivation Protocol Using Various Genome Engineering Tools

Advisor: CHOW King Lau / LIFS
Student: LAM Phoebe Cheuklam / BCB UROP Course: UROP1100, Summer 2016

This project focuses on establishing a marine flatworm of the genus *Convolutriloba sp.* as a model organism for genetic and biological study of symbiosis. The organisms of this genus thrive in nutrient-rich and well-lit aquaria; examples of their short-term culture in laboratory settings have also been reported. Nevertheless, few efforts have been made to define the culture medium and dietary requirements of *Convolutriloba sp.*, which are the key questions of this research. Through literature review and in primary experimentation, *Convolutriloba macropyga* survived at temperatures between 18°C and 28°C, pH between 7.5 and 8.0, salinity between 27 and 35 ppt, and a light–dark cycle of 14 h:10 h. Sexual reproduction was induced by reducing the light regime from an average PAR irradiance of approximately 100 µmol/m²/s¹ to approximately 70 µmol/m²/s¹ at the water surface as well as by feeding the flatworms with more microinvertebrates. Although a healthy and thriving population of *C. macropyga* can now be maintained in a mixed-species aquarium in a laboratory, more experimentation is required to identify the essential ionic and dietary requirements of an axenic culture of *C. macropyga*.

Identification of the Essential Motifs on Arf3 that are Important for Its Function

Advisor: GUO Yusong / LIFS
Student: LIU Yang / BCB UROP Course: UROP1100, Summer 2016

ADP-ribosylation factors (ARFs) are critical regulatory factors that initiate coat protein recruitment and modulate lipid-modifying enzyme activities. In the past decades, the functions of Class I ARFs were widely considered interchangeable. However, recent studies have suggested that Arf3 holds several unexpected properties compared with Arf1. For instance, distinct from other Golgi-localized ARFs, Arf3 selectively localizes on the trans-Golgi network membrane. According to amino acids sequence analysis results, seven amino acids differ between Arf1 and Arf3 both of which are 181–amino-acid long. This variation indicates that some motifs unique to Arf3 may determine its unique localization or membrane trafficking characteristics, which are absent in other Arfs. The objective of this project is to identify these unique motifs on Arf3.

Control of Cell Number in the Brain

Advisor: HERRUP Karl / LIFS Co-advisor: HUNG Siu Chun / LIFS
Student: NG Siu Wang / BIOT UROP Course: UROP1100, Fall 2015

Tissue homogenization is a crucial technique for this UROP project on cell number quantification. However, nuclei aggregation is the major limitation of this method, which hinders cell counting. Therefore, a set of experiments simulating the process was conducted to identify the cause of this nuclei clumping occurring during the preparation of nuclei sample for a quantification experiment. This investigation targeted the following factors: the washing process, paraformaldehyde, calcium ions, chromosomal DNA, and the protein–disulfide bridge. Thus far, the results have indicated that the washing process or calcium ions do not cause the clumping; however, the role of the other factors remains inconclusive because of a lack of evidence. Further investigation is required to identify the main cause of the clumping.

Advisor: HERRUP Karl / LIFS Co-advisor: HUNG Siu Chun / LIFS
Student: TI Chun Hang Eden / CEGBM UROP Course: UROP2100, Fall 2015
UROP3100, Spring 2016

The project addresses the question of whether the cell number in mice cerebellum is more accurately represented by an intrinsic model of cell fate determination dependent on cell lineage or by dependence on cellular interactions and environmental factors. We proposed a model with the following assumptions: (1) the number of cerebellar progenitors follows a normal distribution with a small mean and (2) the progenitors generate a series of clones, each of which has a relatively constant number of cells. The isotropic fractionator was adopted to estimate the cell number in nearly 200 genetically identical half cerebellums. The statistical analysis of the distribution of the counts is better fitted by our predicted multimodal model than by a single-Gaussian distribution. The findings support our hypothesis and may apply to the interpretation of many human developmental disorders.

Advisor: HERRUP Karl / LIFS Co-advisor: HUNG Siu Chun / LIFS
Student: LEE Ho Yin Thomas / BCB UROP Course: UROP1100, Fall 2015
UROP2100, Spring 2016
UROP3100, Summer 2016
Student: PARK Gaeun / BCB UROP Course: UROP1100, Summer 2016
Student: WANG Qingyang / BCB-IRE UROP Course: UROP2100, Fall 2015
UROP3100, Spring 2016
UROP4100, Summer 2016

This project addresses two questions concerning the cell number control during mice brain development: (1) Is the control mechanism intrinsic to cell lineage or largely dependent on extrinsic factors? (2) Is there a resultant

difference caused by these control mechanisms and what is it? The isotropic fractionator was adopted to estimate the cell number in nearly 200 genetically identical half cerebral cortices. Statistical tests revealed differences between sexes for both total brain cell and neuron number. However, little difference was noted between hemispheres. Quantum Gaussian model fitting revealed that the total cortical cell number appeared to be regulated by intrinsic mechanisms; nevertheless, neuronal cell number distribution more accurately resembled single-Gaussian distribution.

Biochemical Characterization of Histone Variants and Post-translationally Modified Nucleosomes

Advisor: ISHIBASHI Toyotaka / LIFS
Student: PANG Yu Hin / BCB UROP Course: UROP3100, Fall 2015
UROP4100, Spring 2016

Nucleosomes are critical structures, functioning as the foundation of chromatin organization, and comprise a central histone core wrapped by an approximately 150-bp DNA. Histone proteins constituting the histone core regulate the physical stability and biological function of nucleosomes. This in vitro study characterized the stability of nucleosomes containing two H2B.FWT variants, namely H2B.FW153T and H2B.FW175T, both of which are specific to cells involved in primate spermatogenesis. Here, reconstituted nucleosomes were subjected to buffers differing in ionic strength and nucleosome dissociation and then assessed using gel mobility shift assays. The results revealed that both the H2B.FWT variants led to a slight weakening effect when incorporated into nucleosome, increasing the probability of partial nucleosome dissociation in an elevated ionic strength environment.

Proteomics Approach to Decipher Gravity Signaling in a Flowering Model Plant

Advisor: LI Ning / LIFS
Student: KO Cheuk Kei / SSCI UROP Course: UROP1100, Summer 2016

Since 1990, studies have demonstrated that repeated mechanical stimuli affect morphology and gene expression in plants. In this study, we compared the responses resulting from different stimuli by using western blotting to analyze certain protein phosphorylation changes in plant tissues after treatment. Two types of sensations, rain and touch with finger, were tested for two treatment durations, 40s and 150 s. Thus far, SEC8 is the only protein being tested; because protein degradation may occur, a solid conclusion could not be reached. Nevertheless, samples stimulated using touch with finger showed that protein levels increase with treatment duration; by contrast, the rain samples showed a decreasing trend of protein levels.

Advisor: LI Ning / LIFS
Student: SEO Heukjin / BCB UROP Course: UROP1100, Summer 2016

Plants respond to stimulations of their environments. The process of changes in the morphology of plants caused by mechanical stress is called thigmomorphogenesis. To understand the cellular signaling mechanism underlying this phenomenon, some proteins involved in the process were analyzed through Western blotting. Wild-type *Arabidopsis* was selected as the model flowering plant and grown for approximately 3 weeks. When these plants were harvested, some were dried with a hair dryer, whereas the others were touched using a cotton stick for either 40s or 150s. The harvested plant tissue samples were ground and proteins were extracted. SDS-PAGE and western blotting were performed on these protein extracts. Chemiluminescence signals of phosphorylated Subunit of Exocyst Complex 8 (pSEC8)—involved in thigmomorphogenesis—were quantified. pSEC8 levels were upregulated in plant tissues when plants were either air-dried or cotton-touched. When stimulation duration was increased from 40s to 150s, western blotting signals also intensified. According to these results, SEC8 phosphorylation may be a part of the cellular signaling cascade for thigmomorphogenesis.

DNA Replication-Initiation Proteins in Budding Yeast

Advisor: LIANG Chun / LIFS
Student: LU Wenxin / BTGBM UROP Course: UROP1100, Spring 2016

DNA replication is a key process involved in cell division; its initiation requires various replication-initiation proteins, such as origin recognition complex (ORC). Recent studies have shown that ORCs may form dimers during DNA replication. Here, we visualized ORC dimerization by transfecting ORC5-HA and ORC5-FLAG into cells and incubating them with anti-Mye (rabbit) and anti-FLAG (mouse) antibodies and then with goat anti-Rabbit IgG H&L (Alexa Fluor® 488) and goat anti-mouse IgG H&L (Alexa Fluor® 594), such that cells with ORC5-HA and ORC5-FLAG emitted green and red color under fluorescent microscopy, respectively. We also stained the cells with DAPI such that DNA emitted blue color under fluorescent microscopy. We then analyzed for the colocalization of ORC5 on DNA fibers in different stages of the cell cycle.

Advisor: LIANG Chun / LIFS
Student: YE Ziyun / SSCI UROP Course: UROP1100, Summer 2016

A previous study showed that the origin recognition complex (ORC) is essential in DNA replication because it recruits replication-initiation proteins, such as Noc3p, Cdt1p, Cdc6p, and Mcm2-7p, to form a prereplication complex. In addition, ORCs form dimer complexes (double-hexamers) during the M-to-G1 transition. The dimer dissociates into monomeric ORC complexes at the origins in S phase. Previous data indicate the presence of an ORC dimerization cycle (AMIN, 2016). To verify this observation, sucrose gradient analysis was conducted for wild-type budding yeast strain (W3031a). To determine the optimum ORC chromatin release conditions for efficient sucrose gradient centrifugation, the effects of salt, detergent, and DNase I treatment conditions were initially examined.

Mechanisms of Lung Cancer Metastasis

Advisor: LIANG Chun / LIFS
Student: SEO Heukjin / BCB UROP Course: UROP1100, Fall 2015

During the UROP1100 course, genes involved in lung cancer metastasis were investigated. First, by reviewing papers, genes involved in the development of cancer and metastasis were studied. BBS4, hypothesized to be a gene involved in metastatic development, was then experimentally studied.

In the general procedure, *BBS4* was knocked down from lung cancer cells through cell transfection. Then, the expression levels of some genes involved in metastasis, such as *SNAI1* and *SNAI2*, were measured using real-time quantitative PCR.

Consequently, the results suggested that silencing *BBS4* reduced the expression of both SNAI1 and SNAI2, indicating that *BBS4* could be an essential gene involved in the development of lung cancer metastasis.

Advisor: LIANG Chun / LIFS
Student: HUANG Xiner / BCB UROP Course: UROP1100, Spring 2016

Cancer has become the second most significant cause of human death. The occurrences and development of most cancers can be traced to mutated or deregulated expressions of a series of genes. The expression of minichromosome maintenance protein complex (MCM), a constituent of DNA prereplication complex that forms at the eukaryotic origin of replication, is upregulated in many cancer types, such as the lung, breast, liver, kidney, lymphoreticular system, and bladder cancers. Thus, cancer development may be suppressed by disrupting the protein interactions within MCM. We screened some substances with a potential cancer-suppressing function by using a yeast two-hybrid system. In this report, some potential compounds have been listed, denoted as H6 and

H7 because they are extracted from herbs. However, more experiments should be performed to confirm its effects. This is a progress report.

Keywords—cancer, minichromosome maintenance protein complex, drug screening.

Advisor: LIANG Chun / LIFS
Student: SAPKOTA Prativa / BCB UROP Course: UROP1100, Spring 2016

Recent studies on budding yeast have suggested that ORC dimerization is essential for prereplication complex (pre-RC) formation and DNA replication. The ORC dimerization cycle proposed in this study indicates a semiconservative model of the chromatin association of ORC. After each round of chromosome duplication, two ORCs on each origin separate and are distributed onto the two nascent chromosomes individually. During the M-to-G1 transition and before pre-RC formation, free ORCs in the nucleus bind replication origins to form dimers with previously bound ORC. Thus, on each chromosome, half of the ORCs come from the parental chromosome and the other half are new. To confirm this process further, the co-localization of ORC in the G1 and M phases of the cell cycle was visualized.

Advisor: LIANG Chun / LIFS
Student: YEUNG Chun Kit / BIOT UROP Course: UROP1000, Summer 2016

Primary cilium, an immobile protrusion of cell membrane present in most mammalian cells, is associated with the formation of many tumors and defects in the bodies. In our experiment, we show that *BBS4*, encoding the cilium protein Bardet-Biedl syndrome 4 protein, affects cilium formation during lung cancer cell cycle and then accelerates the lung cancer cell division. To check this hypothesis, we knocked down *BBS4* and observed changes in the cell cycle. Thus, the mechanism of action of *BBS4* in tumor progression was studied.

Marine Molecular Microbial Ecology

Advisor: LIU Hongbin / LIFS
Student: LEUNG Sze Ki / BISC UROP Course: UROP1100, Fall 2015
UROP2100, Spring 2016

A new primer set was designed to amplify PE-containing *Synechococcus*, an unicellular cyanobacteria that contribute significantly to marine primary production. The efficiency and specificity of the primer was compared with an old primer set B3FW/SynA1R: The two primer sets were used to amplify the DNA of *Synechococcus* with different pigment types and environmental samples from two stations in Hong Kong coastal waters (PM7 and PN05). The new primer set was more specific and efficient in amplifying the DNA of *Synechococcus*, particularly that of type 2 *Synechococcus*. Both primer sets showed that type 2 is dominant in PM7 and type 3 is dominant in PN05; nevertheless, the new primer set can obtain a higher biodiversity in the environmental sample because it has a higher coverage and can amplify a new cluster KORDI 10 times more accurately than the old primer set.

Water Quality Survey for Hong Kong's Marine Fish Farming Zone

Advisor: LIU Hongbin / LIFS Co-advisor: LAU Wing Keung / LIFS
Student: XIAO Yidi / SSCI UROP Course: UROP1000, Summer 2016

The project “Water Quality Survey for Hong Kong's Marine Fish Farming Zone” monitored the water quality of marine fish culture sites in different regions of Hong Kong. Monthly or biweekly surveys of 26 water sampling stations were conducted and hydrographic, water chemistry, and biological parameters, such as suspended solid and chlorophyll-a concentrations, were measured. This report provides data regarding the suspended solid and chlorophyll-a concentrations at nearshore water sampling stations in northeastern and southern areas of Hong Kong. The data were collected in April and May 2016 and analyzed and compared with the water quality at related stations.

The Rules of Packaging Fat in Cells

Advisor: MAK Ho Yi / LIFS
Student: LAU Siu Hang / BIOT UROP Course: UROP1000, Summer 2016

Lipid droplet (LD) is a conserved subcellular organelle related to lipid storage and turnover. By using genetic approaches, researchers have discovered that Seipin plays a role in controlling LD formation and morphology. Through fluorescence microscopy, we observed a novel Seipin-positive tubular structure wrapping some of the LDs under specific conditions. To further characterize these structures, mammalian cell lines expressing exogenous *Caenorhabditis elegan* Seipin were previously generated. The aim of this project is to estimate the copy number of heterologous DNA insertions of these cells by using real-time PCR and the expression levels of SEI-1::Venus fusion protein through Western blotting. The sources of errors and approaches for improving the accuracy of results are also discussed.

Advisor: MAK Ho Yi / LIFS
Student: PARK Jae Soon / BCB UROP Course: UROP1100, Fall 2015
UROP2100, Spring 2016
UROP3100, Summer 2016

The human Atlastin GTPase (ATL) plays a significant role in establishing and maintaining the endoplasmic reticulum (ER) and tubular network. This project aims to use *Caenorhabditis elegans* as a model organism to elucidate the functions of individual conserved domains of ATL. My goal was to engineer analogous mutations found in human ATL1 in *C. elegans atln-1* through the CRISPR/Cas9 system, focusing on potential changes in lipid droplet size and ER morphology. An updated transgene screening method, with the use of Self-Excising Cassette (SEC), has been applied in this project. Here, I report molecular biology experiments for repair template constructions and for SEC insertion into the repair templates.

Characterization of Novel Cell Cycle Regulators in Cancer Cells

Advisor: POON Randy Yat Choi / LIFS
Student: LIUSNANDO Amanda / BIOT UROP Course: UROP1000, Summer 2016

Multiple pathways of DNA damage detection and repair are triggered by a family of proteins called poly(ADP-ribose) polymerases (PARP). The essential role of PARP1 in DNA repair results in potential therapeutic applications of PARP inhibitors (PARPi), which can enhance the cytotoxicity of DNA-damaging anticancer drugs. In this study, I investigated the effects of PARP1 expression levels on the cellular responses toward PARPi. Furthermore, the effects of PARP1 expression on the sensitivity toward Adriamycin, a DNA damaging agent, were examined. My results suggested that increasing PARPi concentration reduces cell survival and that cellular PARP1 levels do not affect responses toward PARPi.

Mitotic Regulators as Targets for Anticancer Therapies

Advisor: POON Randy Yat Choi / LIFS
Student: ZUO Longlong / SSCI-IRE UROP Course: UROP1100, Summer 2016

The cell cycle comprises four stages: G1 (growth), S (synthesis, where DNA replicates), G2 (growth), and M (mitosis, where cells round up and divide). The cell cycle can be tracked using genetically engineered FUCCI cells, which demonstrate different colors at different phases because of individual florescent proteins. I observed that the HT29 cell line could be trapped in mitosis by using antimicrotubule drugs for a prolonged period. To understand the basis of this prolonged mitotic arrest, different chemical inhibitors were used to target various mitotic pathways to disrupt this mitotic arrest. Surprisingly, the mitotic-specific phospho-histone 3 (serine 10) antibody recognized an additional large protein, the identity of which remains undetermined.

Investigating Microtubule Regulation During Cell Proliferation, Migration and Morphogenesis

Advisor: QI Robert Zhong / LIFS
Student: CHEUNG Yuen Man Kathy / BCB-IRE UROP Course: UROP1100, Summer 2016

Microtubules are composed of α-β heterodimers essential in many cellular processes, including protein trafficking and cell migration. They normally nucleate from the γ-tubulin ring complex (γ-TuRC), a 2.2-MDa complex comprising GCP2-6- and γ-tubulin. CDK5RAP2 is a γ-TuRC–associated protein that activates microtubule nucleation from γ-TuRC. In this study, through molecular cloning, we generated a fusion protein of N-terminal CDK5RAP2 and N-terminal TOM20, which can be directed toward mitochondria. By using immunostaining and microtubule regrowth assay, this chimeric protein was found to be able to recruit intact γ-TuRC to mitochondria, which were active for microtubule nucleation.

Bioactive Compounds from Marine Bacteria Associated with Tunicates from the Red Sea

Advisor: QIAN Peiyuan / LIFS
Student: LESNIAK Agnieszka Monika / BCB UROP Course: UROP1100, Fall 2015

UROP 1100 was an intense learning experience, which provided me with knowledge regarding molecular biology techniques as well as experimental design associated with the synthesis of natural bioactive products. In this 3-month-long training, I learned the theory underlying biotechnological procedures and gained insight into marine biology. I joined the course not only to familiarize myself with the major-associated laboratory methods buy also to facilitate my understanding regarding real work and the life of a researcher. Because of the courtesy of Prof. Pei-Yuan Qian and Dr. Yongxin LI, I realized the importance of passion and commitment in a research career.

Advisor: QIAN Peiyuan / LIFS
Student: URIP Brian Anugerah / BIOT UROP Course: UROP1000, Summer 2016

Nowadays, antimicrobial substance resistance has been increasing. Earth is surely encountering a massive, developing threat from the emerging bacterial pathogens that are now resistant to almost all known antibiotics, previously used to treat them. However, the progress of developing new antimicrobial substances, required for combating against these bacteria, is slow. Most previously discovered antibiotics were produced through soil microorganism screening. However, by 1960, this limited source was already overused. Therefore, a new class of antimicrobial substance is required to fight these pathogens resistant to existing antibiotics. This study focused on a new substance, our laboratory purified previously. A bioassay was performed to predict the MIC of this substance, followed by an antibiofilm test by using Bogorol samples.

Development of Advanced Controlled Release System for Natural Product Based Antifoulants

Advisor: QIAN Peiyuan / LIFS Co-advisor: MA Chunfeng / LIFS
Student: LAM Wai Yun / CHEM UROP Course: UROP1100, Spring 2016
UROP2100, Summer 2016

Nonrenewable energy preservation is crucial because this type of energy tends to become exhausted within several years. In marine transportation, biofouling has increased energy use significantly. Materials used for preventing biofouling on the bottom of ship are called antifoulants. Along with killing biofouling species efficiently, environmental protection is also necessary. Therefore, antifoulants should be highly selective toward the target species. In addition, the rate of antifoulant release from the bottom surface of a ship should be considered. If the rate is too high, it can cause the unsustainability of antifoulant, whereas if it is too low, the low antifoulant concentrations cannot kill the biofouling species. Thus, an optimum releasing rate must be estimated by coupling an antifoulant with different polymers.

Study of Blood Cell Development using the Zebrafish Model

Advisor: WEN Zilong / LIFS
Student: SHI Hongyu / BCB — UROP Course: UROP2100, Fall 2015; UROP3100, Spring 2016; UROP4100, Summer 2016

In my past two UROP reports, I described the differences between *itga4*$^{-/-}$ zebrafish and its siblings in hematopoietic stem cell development and definitive erythropoiesis. A possible explanation for these differences is impaired cell mobilization resulting from *itga4* dysfunction. Although our previous experiments did not exclude other possible explanations, in this summer's UROP project, we used only *itga4*$^{-/-}$ zebrafish and its siblings to reveal the potential effects of *itga4* on definitive mylopoiesis and lymphopoiesis. In situ hybridization was performed using two myeloid markers, *lyz* and *mfap4*, and one lymphoid marker, *lck*. Thus far, we have observed no differences between *itga4*$^{-/-}$ zebrafish and its siblings in these experiments, suggesting that either *itga4* dysfunction has little effect on definitive myelophoiesis and lymphopoiesis in zebrafish or its influence is too subtle to be revealed in our experiments. Our previous hypothesis that defective cell mobilization caused by *itga4* mutations results in the phenotype change remains consistent with all results obtained thus far. Additional experiments are required to elucidate the relationship between *itga4* and definitive hematopoiesis in zebrafish.

Benthic Dinoflagellates of Hong Kong

Advisor: WONG Joseph Tin Yum / LIFS
Student: CHAN Tat Yin / ENVS-IRE — UROP Course: UROP1100, Spring 2016
Student: LEUNG Pok Man / ENVS — UROP Course: UROP1100, Spring 2016

Dinoflagellates, a large group of protists belonging to the phylum Dinoflagellata and living in an aquatic environment, have been widely studied, particularly for their notorious roles in causing harmful algal blooms; however, research conducted on these species in the Hong Kong environment has been limited. Therefore, our study focused on the isolation and characterization of benthic dinoflagellates from an environmental sample from Clear Water Bay, Hong Kong. Suspected dinoflagellate strains were isolated and cultivated on microtiter plates, two of which displayed different morphologies and more prominent growth; these species were then characterized through light microscopy and genomic sequencing of their large and small subunit rRNA genes.

Human Complex Disease Genomics and Bioinformatics

Advisor: XUE Hong / LIFS — Co-advisor: LIANG Chun / LIFS
Student: LAI Yuen Yee / BCB — UROP Course: UROP1100, Spring 2016

This study aims to examine the variations in DNA sequences in lung cancer patients through next-generation sequencing (NGS; e.g., Ilumina sequencing). Eight DNA samples of normal and tumorous lung tissues were obtained from four individuals. Cancerous and normal lung tissues from the same lung patient were first extracted using cell-lysing agents and amplified through both Inter-Alu PCR and PCR amplification with a KOD mix. The AluScan and Inter-Alu PCR methods was first performed to reduce initial DNA requirements for NGS and the other PCR was performed after adaptor ligation by adding an index for library construction.

Advisor: XUE Hong / LIFS — Co-advisor: LIANG Chun / LIFS
Student: WONG Chau Wing / BICH — UROP Course: UROP1100, Spring 2016

DNA mutation can cause cancers. By extracting and analyzing genomic DNA of cancer and normal cells, we may identify the DNA changes in cancer cells and the association of the effects of these changes with the causes of the cancers. Thus, this experiment aims to extract genomic DNA of cancer and normal cells by using inter-Alu PCR and to prepare the eluted DNA for next-generation sequencing techniques. The preparation steps for next-generation

sequencing techniques include DNA fragmentation, end repairing, 3'-end adenylation, adaptor ligation, and PCR amplification.

Receptor Based Drug Development from Chinese Herbal Medicine

Advisor: XUE Hong / LIFS
Student: JANG Yun Ji / BCB UROP Course: UROP1100, Fall 2015

The purpose of this experiment was to examine the effectiveness of combined herbal medicines as an anxiolytic drug. A drug composed of two traditional Chinese herbal medicines, Chai Wu and He Huan Hua, was injected to ICR mice for observation. Each mouse was administered a 120-mg/kg dosage of the drug and examined with the elevated plus maze test to observe the anxiolytic effect. Compared with the control group, the drug-injected mice presented an increased time in open arm, demonstrating the drug's effect as an anxiolytic. Moreover, the mice were investigated using additional behavioral characterization tests, implying that the drug had no side effects causing sedation leading to decreased locomotor activity. Consequently, some degree of anxiolytic effect of the drug and absence of sedation as a side effect indicates a potential use of Chai Wu and He Huan Hua as a future anxiolytic drug.

Advisor: XUE Hong / LIFS
Student: PARK Juyeon / BIOL UROP Course: UROP1100, Spring 2016

This report shows the progress of cell line research conducted under the Undergraduate Research Opportunity Program. Cell line analysis was conducted to investigate a receptor-based drug from traditional Chinese medicine on cells and its therapeutic effectiveness on cancer cells. I was involved in three major parts of this research: cell culturing, cell toxicity assay, and cell cycle analysis. I spent the majority of the time on cell culturing—cells were cultured for passaging, toxicity assays, DNA and RNA extraction, and DNA library construction. The cell assays involved observing differences in the morphological behaviors of cancer cells HeLa and MCF after treatment with the drug at different doses. The cell cycle assays was performed to reveal the DNA content of cancer cells in respective cell cycle stages. Because the project is still in progress, deducing a firm conclusion will be difficult. However, as indicated by the decreased cell count and abnormal DNA content in the G2 phase after high-dose drug treatment, our herbal-based drug may be effective.

Molecular Mechanism of Cell Competition and Tumorigenesis

Advisor: YAN Yan / LIFS
Student: LI Dazhi / SSCI UROP Course: UROP1000, Summer 2016

Cell competition is a process responsible for surviving winner cells and eliminating loser cells, which in part accounts for the tumor initiation microenvironment. Although studies on cell competition have revealed that genes translation rates and cell polarity highly affect cell competition ability, the underlying mechanism remains unclear. Here, we used *Drosophila melanogaster* as the research tool to reveal the underlying genetic linkage of neoplastic tumor suppressor gene mutant-induced cell competition through genetic screening. We have screened out a few strains with positive results. This article reports the details of this project thus far, including some of the recent progress in experiments.

Department of Mathematics

Statistical Analysis in Portfolio Construction

Advisor: CHEN Kani / MATH
Student: NGAI Ying Tim / MAEC UROP Course: UROP1100, Spring 2016

This research focused on designing an algorithmic trading strategy based on efficient market hypothesis (EFH). However, because the existence of market inefficiency has not been reported, I designed a factor that can reflect the degree of market inefficiency, based on which I constructed a systematic trading strategy. This report introduces the theoretical background of this topic and how the algorithmic trading system was constructed. The strategy was applied to three markets—Hong Kong, Mainland China and the United States. The results were interpreted to verify the credibility of the model and adjust parameters for optimizing the performance of the strategy.

Advisor: CHEN Kani / MATH
Student: JIA He / COSC UROP Course: UROP1100, Summer 2016
Student: WANG Chuning / MATH-IRE UROP Course: UROP1100, Summer 2016
Student: ZHOU Yanjun / MATH-SF UROP Course: UROP1000, Summer 2016

This paper uses neural networks to forecast financial market and make profit. The approach adopted is training and testing a multilayer Perceptron neural network (MLP) and Elman recurrent neural network (ERNN) as well as some other approaches, including simple ones, such as linear regression. The performances of models are then evaluated and compared with each other. All prediction results reported in this paper; among all approaches, the linear model showed the most favorable performance. Our results demonstrate that capturing the patterns of the effects of various factors on how stock indices by using MLP and ERNN is relatively difficult. Further improvement in neural networks may be required for more accurate financial forecasting.

Geometric Flows

Advisor: FONG Tsz Ho / MATH
Student: CHOW Tsz Kiu Aaron / PHYS-IRE UROP Course: UROP1100, Summer 2016

In this expository article, we deepen our understanding and refine some proofs of Huisken's 1984 paper on the mean curvature flow of hypersurfaces. First, the evolution equations of some geometric quantities are derived in section 3. Section 4 then indicates that the surface preserves its convexity. The bounds are then derived for the gradient of the mean curvature in section 6 and for the higher derivatives of the second fundamental form in section 7. Finally, section 8 concludes that the surfaces converge to a single point.

Advisor: FONG Tsz Ho / MATH
Student: CHOY Ka Hei / CENG UROP Course: UROP1100, Summer 2016

Geometric flow is a branch of differential geometry, which is a study of the time behavior of manifolds as well as some geometric parameters, such as curvature, length, and enclosed area. This UROP project is written to deepen the understanding of the curve-shortening flow of curves in the Euclidean plane.

Advisor: FONG Tsz Ho / MATH
Student: LAM Tsz Ki / SENG UROP Course: UROP1100, Summer 2016

This article studies the flow of smooth curves in a 2D Euclidean plane directed along the normal with speed proportional to the curvature; it is a one-dimensional case of mean curvature flow. At the end of the article, long- and short-time existence is proved, indicating that convex curves evolve to a zero-area object. It is closely related

to studies in heat equations. This paper may act as an introduction to geometric flows or as a bridge to the more advanced mean curvature flow.

Advisor: FONG Tsz Ho / MATH
Student: MAN Chun Hin Derek / SSCI UROP Course: UROP1100, Summer 2016

The goal of this paper is to show that under curve-shortening flow, any embedded curve with strict convexity will shrink to a single point. The first section will introduce curve-shortening flow and indicate the conditions under which the curve will keep flowing. The second section will attempt to bound the curvature, such that the curve is allowed to flow in a finite time interval. The third section will show that the curve will stop flowing at a certain time and how it behaves. The concluding section will prove that the curve finally shrinks to a point.

Advisor: FONG Tsz Ho / MATH
Student: TAM Kwok Chung / MATH-PM UROP Course: UROP1000, Summer 2016

In this report, we deepen our understanding of Huisken's 1984 paper on mean curvature flow with elementary knowledge in differential geometry and tensor calculus at the undergraduate level. We aim at understanding the arguments in sections 3–8 to explore how a compact, uniformly convex, closed surface shrinks to one single point under mean curvature flow. To adjust the difficulty of the project, we attempt to only understanding the propositions in section 5, without deriving the proofs at the elementary level, while focusing on the arguments in section 8 and on the uses of evolutions developed in sections 3 and 6.

Adaptive Learning

Advisor: HU Jishan / MATH Co-advisor: ZHANG Xiaoquan / ISOM
Student: HARB Elfarouk Yasser Farouk Mohamed / SSCI UROP Course: UROP1000, Summer 2016

The aim of this project was to develop an application that runs on Android and iOS operating systems for the STeP website. The purpose of this app is to allow students to submit homework through a digitalized image captured by their phones. The students capture a QR code that has the information of the homework book and questions required. The app initializes these questions and allows the student to capture images of solutions by using their phones. The student can then preview the captured photo, and if needed, sketch on the picture to add additional illustrations. Once the student has captured the photos of all homework questions, the student can submit it to the servers to be added to the database.

Advisor: HU Jishan / MATH Co-advisor: ZHANG Xiaoquan / ISOM
Student: LAM Ho Shan / SENG UROP Course: UROP1000, Summer 2016

The apriori algorithm is a simple association rule mining method over transactional databases. The aim of our project is to develop a prototype that generates a knowledge map of commonly misunderstood concepts on the basis of a group of university students' problem-solving records on an online problem set database by using the apriori algorithm as the primary approach. The traditional apriori algorithm determines the strength of associations on the basis of the cooccurrences of items only; however, under the context of this project, considering the answering patterns and the sequences of right and wrong answering attempts of students may be useful for obtaining rules of higher reliability. With examples, we compare results obtained from the classical and a modified apriori algorithm.

Keywords—datamining, association rules.

Advisor: HU Jishan / MATH Co-advisor: ZHANG Xiaoquan / ISOM
Student: SHI Zhenmei / SENG UROP Course: UROP1000, Summer 2016

This report mainly introduces how to use Stanford CoreNLP in the search engine of a particular database. In this report, a database that records mathematics problems and grades of university students is used as an example. This report has four parts: The first part introduces how to get keywords or key-phrases from a question. The second part is on how to use JDBC in Java to connect to MySQL to acquire data that are to be used. The third part discusses the calculation of the information entropy of the keywords or key-phrases. The final part describes obtaining expected results applicable to a particular database by using the information entropy of keywords and key-phrases, to allocate each problem a weight.

Advisor: HU Jishan / MATH Co-advisor: ZHANG Xiaoquan / ISOM
Student: SONG Jiuwu / COSC UROP Course: UROP1000, Summer 2016

In this study of mathematics, we determined whether knowledge background or study habits matter more in examination grades. Based on the data we retrieved from the STEP website, we acquired two sets of records: (i) the correctness of the questions in the website, which can be regarded as the knowledge background. (ii) The results of a series behavior record, such as login frequency, total click times, and time spent on each topic; this record will be regarded as the study habits of the students. We will use these two sets of records to form a behavior matrix, followed by the use of a collaborative filtering algorithm to identify students with similar behavior types. We use the degree of similarity to measure how similar they are. We then retrieve the midterm and final examination results of the students and then compare the examination grade differences between students and check the similarity among them. After examining the method showing a more accurate estimate, we conclude that background knowledge matters more with regard to examination grades than do study habits.

Advisor: HU Jishan / MATH Co-advisor: ZHANG Xiaoquan / ISOM
Student: XU Xiaofeng / SSCI UROP Course: UROP1000, Summer 2016

We study the effects of different time periods during the week on students' usage of the E-platform. We also study the effect of examination and other people's usage on an individual student's E-platform usage. We developed a hidden Markov model to model and represent these effects and study the relationship among these factors. The final purpose of this study is to reveal the time that a student would dedicate to the E-platform, so that we can distribute the online work appropriately and achieve high efficiency in students' study.

Department of Physics

Ultrahigh Vacuum System for Surface Science

Advisor: ALTMAN Michael Scott / PHYS
Co-advisor: LIN Nian / PHYS
Student: HE Pingge / PHYS
UROP Course: UROP1100, Fall 2015
Student: LI Tianhao / PHYS
UROP Course: UROP1100, Fall 2015

Auger electron spectroscopy (AES) and low-energy electron diffraction (LEED) are two techniques commonly used to obtain information regarding the chemical composition and surface structure of crystalline samples, respectively. This article describes a system with LEED optics constructed for performing both AES and LEED experiments. Despite the relatively high pressure in the vacuum chamber, both experiments efficiently reported Auger spectra and LEED patterns, acquired using annealing. A system using cylindrical mirror analyzer (CMA) was also constructed, and the optimum operation conditions for multiple parameters, such as modulation frequency and amplitude, were investigated.

Light-Sheet Microscopy

Advisor: DU Shengwang / PHYS
Co-advisor: LOY Michael Ming-tak / PHYS
Student: LAU Sze Cheung / PHYS-IRE
UROP Course: UROP1100, Fall 2015

The lattice light-sheet microscope was recently introduced; it uses a fast-switching SLM displaying bound optical lattice cross-section through a fixed annular ring on the back (pupil) plane of the excitation objective to create a nondiffracting lattice light-sheet, thus achieving high resolution and low photo-bleaching. In this report, we propose and demonstrate an alternative method to create a multilayer nondiffracting light-sheet named patterned Bessel light-sheet (PBL). We replaced the fixed annular mask with a set of switchable rings to accommodate the wavelength dependence of the diffraction pattern and replaced SLM with a fixed photomask to reduce the complexity and cost of the system but simultaneously increased the light diffraction efficiency. Imaging of various samples indicated that our system has high resolution as well as low phototoxicity and can perform both long-term and rapid live imaging.

Advisor: DU Shengwang / PHYS
Co-advisor: LOY Michael Ming-tak / PHYS
Student: LUI Ming Hong / BCB-IRE
UROP Course: UROP1100, Fall 2015
UROP2100, Summer 2016

Dual-view inverted selective plane illumination microscopy (diSPIM) is a distinct type of light-sheet microscopy. In addition to the advantages conferred by the light-sheet, including high speed and low phototoxicity, diSPIM can achieve high isotropic spatial resolution with joint-view image fusion. However, achieving this theoretical goal requires practical manipulation of the microscope involving assembly, coupling, operation, and maintenance as well as post-imaging data processing. In this study, I redesigned the existing laser pathway to incorporate multichannel imaging and wrote supporting programs to enhance diSPIM for large sample imaging and its associated image processing and reconstruction. Zebrafish and mouse brain slices were imaged and processed throughout the project.

Quantum Optics and Atomic Physics

Advisor: DU Shengwang / PHYS
Student: CHOW Tsz Kiu Aaron / PHYS-IRE
UROP Course: UROP1100, Fall 2015
UROP2100, Spring 2016

In the information era, the power of computation has become indispensable to our society. The classical computer has been widely used for assisting mankind in solving many problems. However, because of the intrinsic limitations caused by atomic size, the computation power of classical computers, with

semiconductor-based CPUs, is being reduced. By contrast, quantum computation, which promises to revolutionize classical computers, is rapidly developing. In this paper, we first discuss the basic concepts of quantum computation, followed by two crucial quantum gates, which are the basic building blocks of quantum computation. We then demonstrate the power of quantum computation by using the Deutsch–Jozsa problem. Finally, two experimental protocols for recognizing quantum gates are introduced.

Advisor: DU Shengwang / PHYS
Student: ZHU Lingbang / SSCI-IRE UROP Course: UROP1000, Summer 2016

We generated entangled narrowband bi-photon pairs through the spontaneous four wave mixing (sFWM) process in a hot rubidium vapor cell. Optical pumping light is transmitted through the cell to reduce the noise level. By adjusting optical pumping power and spatial form, we extensively studied the optical pumping effect, potentially reducing the noise ratio further and entering the grouped delay regime resembling bi-photon generation in the laser-cooled atom ensemble system.

Building a Ultrastable Laser System for Exciting Metastable Ytterbium Atoms

Advisor: JO Gyu Boong / PHYS
Student: XIAO Yao / PHYS UROP Course: UROP1100, Summer 2016

In electronic industries and studies, proportional–integral–derivative (PID) control is a common part of most controlling systems. Its considerable functionality is highly useful in laser and atomic physics to achieve stable experimental conditions and outputs. This report derives some basis quantitative relations in a typical PID control in the first section and then focus on a particular design of op-amp–based PID control used in the stabilization of laser intensity. Technical operations will be discussed in Section 2.

Building Quantum Gas Microsopy with Ultracold Ytterbium Atoms

Advisor: JO Gyu Boong / PHYS
Student: CAI Geyue / PHYS-IRE UROP Course: UROP3100, Fall 2015

In recent years, several innovative methods for cold atom-related experiments have been developed. One of them is the application of in situ imaging techniques, which reveals the position information of cold atoms with high precision and accuracy. These techniques are suitable alternatives for the traditional time-of-flight method, which can only indicate the momentum distribution of trapped atoms. However, the implementation of in situ imaging techniques can be difficult in practice. This report first discusses the theoretical basis for building this microscopy and then presents some possible proposals for resolving the actual issues.

Advisor: JO Gyu Boong / PHYS
Student: CHAN Wing Kin / PHYS-IRE UROP Course: UROP2100, Fall 2015
UROP3100, Spring 2016

On completing TEM_{01}* setup from the bread-broad, twitches have to be performed to accommodate TEM_{01}* in the actual implementation. On planning the installation, components in the original magnetic optical trap setup (MOT) have to be replaced and additional lenses are required for magnifying the beam. In addition to its implementation, the parameters, such as intensity, diameter, and detuning, are considered with reference to a previous study, which used a similar setup extensively. The results of this paper will be the starting point of setting up these parameters and making improvements based on them.

Characterize Single-molecule Electronic Properties Using Low-temperature Scanning Tunneling Microscopy

Advisor: LIN Nian / PHYS
Student: WANG Ziqi / SSCI UROP Course: UROP1000, Summer 2016

The main theme of this research is to study surface-assisted supramolecular self-assembly by using scanning tunneling microscopy (STM) as an experimental tool to characterize the structures of metal–organic systems and to investigate the mechanisms of self-assembly and polymerization processes. A scanning tunneling microscope is an instrument for imaging surfaces at an atomic level. It can facilitate researchers in directly observing the formation of multicomponent supramolecular self-assembly. This report mainly focuses on the experimental techniques and preparation for scanning.

Monte Carlo Simulation of 2D Supramolecular Assembly

Advisor: LIN Nian / PHYS
Student: CAI Qianhang / PHYS-IRE UROP Course: UROP1100, Fall 2015

To investigate the 2-dimensional metal–organic supramolecular self-assembly on lattice substrates, a simulation program adopting the kinetic Monte Carlo (KMC) method was constructed by former researchers. It was designed to simulate the network development process of TPyP (a type of porphyrin molecules) and lead atoms on Au(111) substrates under different experimental conditions; it was successful in explaining the experimental results. This report will focus on explaining the guiding ideology of the program, along with why the KMC method was chosen and how it was applied to this particular simulating system.

Advisor: LIN Nian / PHYS
Student: GAO Huaxuan / SSCI UROP Course: UROP1000, Summer 2016

To explore the reaction conditions and simulate the possible outcomes of certain metal–organic supramolecular self-assembly on lattice substrates, a computer program, using kinetic Monte Carlo (KMC) method to simulate the reactions, was constructed by previous researchers. This report first introduces the background of this research, followed by the introduction to the KMC method. Next, the relationship between several variables in the program, such as environmental temperature and energy barrier, and their influence on the simulated outcome are discussed.

Keywords—supramolecular self-assembly, metal–organic framework, Monte Carlo method, simulation.

Advisor: LIN Nian / PHYS
Student: ZHANG Tianpeng / SENG UROP Course: UROP1000, Summer 2016

To study the self-assembly process between a Tpyp molecule and Pb atoms on a 2D substrate, a simulation program using the kinetic Monte Carlo (KMC) algorithm was adopted from former programmers and simulations were created. This report first discusses the physics model used and how the program implementation interprets the physics model and then presents the simulation result demonstrating the time-evolution process of the assembly system, along with strategies that aid in eliminating the formation of a metal island and obtaining a stable metal–organic network and the behavior of the system under different molecule symmetry settings.

Quantum State Calculation of Two-dimensional Supramolecular Nanostructures

Advisor: LIN Nian / PHYS
Student: WU Tsz Chun / PHYS-IRE UROP Course: UROP1100, Fall 2015

We report the investigation of graphene edge states with triangular, diamond-like, and bowtie-like geometries. Our results are in general agreement with previous results. Zero-energy edge states are observed in ribbons with zigzag edges only. Furthermore, we studied the effect of periodic grains on graphene circular ribbon. For the hexagonal geometry, our quantitative results for band structure corroborate those of previous studies; however, our plots of the density of states are in contrast to those reported previously.

Advisor: LIN Nian / PHYS
Student: YANG Tianyi / PHYS UROP Course: UROP2100, Fall 2015

This research is an extension of a previous study on the same topic. This project aimed to apply the method in solid-state physics to finite lattice structure to approach an infinite structure of benzenes, known as graphene. My project focused on modifying a tight-binding module to examine the large system of benzenes in two dimensions. Consequently, the modified program calculated an even larger system, and some expected simulated graphs, with some extreme states behaving abnormally.

Advisor: LIN Nian / PHYS
Student: NGAI Tsz Ue / SSCI UROP Course: UROP1000, Summer 2016

The electron band structure in a two-dimensional periodic hexagonal lattice can be calculated by solving the Schrödinger equation by using computer programs, such as MATLAB. This report focuses on the behavior of an electron in triangularly group pillars in a hexagonal lattice to provide supplementary evidence to another study on deformed hexagonal structures, which can be tested by truncated graphene. The results present convincing band splitting and change in eigenstates energy potential. The calculated LDOS can later be compared with the experimental scanning tunneling spectroscopy measurements performed on an actual sample with a similar structure.

Advisor: LIN Nian / PHYS
Student: XIE Ayu / PHYS-PM UROP Course: UROP1100, Fall 2015
UROP2100, Summer 2016

A previously designed MATLAB program was used to simulate the electron property of a 2D system imposed by a periodic potential by numerically solving the time-independent Schrödinger equation. This project aims to study the finite structure of graphene, such as finite hexagonal structure and finite triangular structure, and to study the phenomenon of edge states forming zigzag and armchair edges.

Investigation of the Nature of the Nematic Order in Fe-based Superconductors

Advisor: LORTZ Rolf Walter / PHYS
Student: LEE Mang Hei Gordon / PHYS-IRE UROP Course: UROP1100, Summer 2016

A crucial characteristic of iron-based superconductors is the presence of an electronic nematic order at a lower doping level, which breaks the tetragonal rotational symmetry of the lattice and develops along with an antiferromagnetic spin density wave order. The thermoelectric Nernst effect is sensitive to the nematic order, and the Nernst signal is strongly enhanced in the presence of the nematic order. To further understand this electronic order in iron-based superconductors, the Nernst coefficient is measured. The coefficient is then compared with the Sondheimer term to see whether the signal originates from unusual electronic correlation effects. The nematic and spin density wave states elicit a large Nernst signal of 20–70 K. Although its magnitude is approximately one order of magnitude smaller than the Sondheimer term, it is still significantly enhanced by the nematic order. In an additional phase below 28 K, the high temperature tetragonal crystalline symmetry is restored. The Nernst coefficient remains at an unchanged large value at this transition, suggesting that the electronic nematic order is not lost in this phase, but develops a distinct orbital order that no longer reduces the crystalline symmetry.

Causality in Big Data

Advisor: SZETO Kwok Yip / PHYS
Student: LIU Chung Him / PHYS UROP Course: UROP1100, Spring 2016

Genetic algorithms are powerful random search algorithms. This report focuses on the mutation only genetic algorithms.

Advisor: SZETO Kwok Yip / PHYS
Student: YIP Chun Yin / PHYS UROP Course: UROP1100, Spring 2016

With the increase in our society, various complex networks, such as social, traffic, and banks network, develop. These networks often need rewiring for certain purposes, such as maintaining money flow to a bank to prevent bankruptcy. This report aims to solve this type of optimization problem. It first implements a genetic algorithm with Python and studies its application in real-life problems, such as multiple extrema and cryptarithmetic problems. Simultaneously, it studies basic properties, including the degree, path length, and clustering coefficient, of a network, in a particular small-world network. Finally, it tunes the genetic algorithm to combine with network physics and use it for an optimization network structure.

Basic properties, including the degree, path length, and clustering coefficient, of a network, in a particular small-world network are mathematically described using the Watt-Strogatz model. Finally, it optimizes tuning the genetic algorithm to be employed in network physics and for improving a network structure.

Keywords–genetic algorithm, Python, small-world networks, clustering coefficient, shortest path length, multiple extrema problem, cryptarithmetic problem.

Chaotic Dynamics in Complex Network

Advisor: SZETO Kwok Yip / PHYS
Student: TSO Yee Ming / SSCI-IRE UROP Course: UROP1000, Summer 2016

This report focuses on the investigation of Duffing oscillators, including the dynamics of a single oscillator system as well as the behaviors of a coupled system. The graphs of trajectories of the oscillator were plotted to observe the dynamics. The frequency–response curves of the single Duffing oscillator system were also plotted. Furthermore, the effects of white Gaussian noise on the coupled oscillator, along with its effects on synchronization, were investigated. In addition, the report introduces a coupled system under the influence of colored noise, with the formulation of the model, and details of the concepts of chaos measurement, with the Lyapunov exponent.

Advisor: SZETO Kwok Yip / PHYS
Student: WONG King Chun / SSCI UROP Course: UROP1000, Summer 2016

A major topic in chaotic dynamics is chaos synchronization. Through chaos synchronization, multiple identical nonlinear systems can be synchronized to follow the same trajectory despite chaotic characteristics in their motion, particularly the extreme sensitivity to initial conditions—an indicator of chaotic systems. This report briefly discusses the mechanism of the process, followed by a geometric interpretation of synchronization. The discussion is then extended to more practical cases of synchronization under background noise. The behavior of synchronization under the influence of noise is then analyzed by using a numerical method, both qualitatively and quantitatively.

Evolutionary Computation for Optimization

Advisor: SZETO Kwok Yip / PHYS
Student: BAT-ERDENE Bat-amgalan / PHYS-IRE UROP Course: UROP1100, Fall 2015

Optimization problems are quite prevalent in many fields, including those of science, engineering, and economics. A method of evolutionary computation, genetic algorithms, can be used for solving these optimization problems. The idea of genetic algorithms is somewhat based on the functioning of natural species evolution. This enables

genetic algorithms to determine near-optimum solutions, without completely understanding the function of optimality. Therefore, genetic algorithms are quite an effective tool for solving complex optimization problems. The subsequent projects aim to use genetic algorithms for determining the global maximum of a function, adaptive mutation matrices, and the optimum solution for noise-introduced functions.

Advisor: SZETO Kwok Yip / PHYS
Student: NG Yan Ho Matthew / PHYS UROP Course: UROP1100, Fall 2015

Genetic algorithms (GAs) are a useful method for solving various optimization problems. GAs are based on the concept of Darwin's Theory of Evolution, in which poor performers would be eliminated and good performers would be maintained. Mutation was used to optimize functions in this research. In the first part, simple GAs and different forms of mutation matrices were compared to search for more appropriate methods for function optimization. In the second part, noise was introduced to the function and its effects on function optimization were examined using the mutation matrix. In conclusion, mutation matrices were more appropriate for function optimization than were simple GAs, and the introduction of noise generally reduced the accuracy in both locating the input and output of the optimized point.

Advisor: SZETO Kwok Yip / PHYS
Student: CHAUDHRY Mukund / SSCI UROP Course: UROP1000, Summer 2016

A genetic algorithm is used to render an image using a small, fixed number of translucent shapes. A solution set comprising chromosomes is evolved using a mutation only genetic algorithm to render an image, which highly resembles its original counterpart. A single chromosome holds one solution (i.e. one particular rendering) and comprises parameters required for rendering different shapes. The image is formed by rendering different layers on top of one another. In addition, a gradient detection algorithm is used for detecting boundary and regions, which requires a rendering in great detail. The results of a gradient detection algorithm are then used to select the regions where the topmost layers are to be formed. The fitness is evaluated by performing a pixel-by-pixel comparison of the original image to the rendered version.

Advisor: SZETO Kwok Yip / PHYS
Student: CHUNG Yuen Ting / PHYS UROP Course: UROP1000, Summer 2016

A double major in physics and computer science is a popular choice at the Hong Kong University of Science and Technology (HKUST); therefore, the most suitable pathway for examining this combination needs to be investigated. A genetic algorithm is a tool used for solving optimization problems on the basis of the Darwinian idea of the survival of the fittest. This tool presents solutions that are represented in the form of chromosomes; crossovers and mutations of these solutions with other solutions are performed to produce a new generation with higher fitness. In this report, genetic algorithms, particularly mutation only genetic algorithms, were used to determine the optimal solution for identifying the most suitable pathway for double majors in physics and computer science.

Advisor: SZETO Kwok Yip / PHYS
Student: LIU Chung Him / PHYS UROP Course: UROP1000, Summer 2016

Genetic algorithms have been efficiently used in many areas for optimization problems. The performance of genetic algorithms in a variable parameter situation is of interest. This study designed a management problem for testing and used two approaches to solve the problem—one based on the knapsack problem, the other based on the open job shop problem.

Maxwell's Demon and Information Thermodynamics

Advisor: SZETO Kwok Yip / PHYS
Student: IYER Aditya Varna / PHYS-IRE UROP Course: UROP1100, Fall 2015
UROP2100, Spring 2016

We investigated the wealth evolution of clusters of players, each characterized by different values of a greed parameter. The system under investigation is a two-state system, where players can either cooperate or defect. After a certain number of decision-making moves, the defectors are rewired to different clusters following a certain rule. Here, several interesting phenomena emerged, which are discussed subsequently.

Advisor: SZETO Kwok Yip / PHYS
Student: CHEUNG Long Him / SSCI-IRE UROP Course: UROP1000, Summer 2016

Information Engine, making use of the idea of Maxwell's demon, can deliver work by rectifying thermal fluctuation from the reservoir, while simultaneously gaining information. The concept of Maxwell demon's was first introduced by James Clerk Maxwell as a thought experiment. In the thought experiment, an intelligent creature, called a demon, is available to produce usable work by gaining information. This leads to the idea that information is a type of entropy and hence the creation of an information engine is possible. An autonomous Maxwell's demon model has been introduced with the exact steady-state behavior being solved. Here, we studied the model and reproduced the result.

Quantum Random Walk on Networks

Advisor: SZETO Kwok Yip / PHYS
Student: SAN Yik Chuen / PHYS-IRE UROP Course: UROP1100, Fall 2015
UROP2100, Spring 2016

In this project, we investigate the general behavior of quantum walk, which primarily occurs in one dimension and is characterized by two operations: tossing a coin and moving according to the result of the coin toss. In particular, we first introduce the well-known, basic concepts from one-particle one-dimensional quantum walk. We then generalize this notion to two-particle quantum walk by discussing how one should define the kinematics and dynamics for such a system. Finally, we conclude with the future outlook of this project by indicating the possible generalizations and other problems in this field.

Advisor: SZETO Kwok Yip / PHYS
Student: WANG Juntao / PHYS UROP Course: UROP1100, Fall 2015
UROP2100, Spring 2016

One-dimensional quantum random walk is generalized by a 2 × 2 unitary coin with four parameters. High-dimensional quantum random walk demonstrates the existence of quantum entanglement. We studied two-dimensional random walk by introducing a new 4 × 4 unitary operator. Moreover, we studied one-dimensional quantum random walk with a multiple random-distributed defects model, such that we could simulate the electron behaviors in graphene by assuming the weak interaction in the y direction. From the simulation results, this model can potentially explain the quantum capacitance behavior in impure graphene by fitting the parameters of quantum coins.

Advisor: SZETO Kwok Yip / PHYS
Student: YU Yue / PHYS-IRE UROP Course: UROP3100, Fall 2015
UROP4100, Spring 2016

We studied the evolution of an initially delocalized ground state of quantum walk on a finite wire under a periodic small increment of vector potential. We observed that the intrinsic oscillation of the two topologically protected

bound states, which are the Majorana modes, was enveloped by a periodic oscillation controllable by the incremental vector potential α. The interaction between the two topologically protected bound states was exactly calculable for the quantum wire and depended only on the inertial parameter θ in the coin matrix and the length of the wire. This interaction energy, determining the intrinsic oscillation between the two ground states, had a distinguishably long period. By adding an α impulse at the end of each intrinsic period, the system could be approximately reduced to a two-level system, and the beat oscillation between these two ground states could be detected and computed. By using beat oscillation, the delocalized ground state could be detected, indicating a potential application in the preparation of decoherence-free qubit in a trapped ion chain.

Random Walk on Complex Network and Application to Numerical Simulation for Statistical Physics

Advisor: SZETO Kwok Yip / PHYS
Student: SOU Chon Man / PHYS-IRE UROP Course: UROP1100, Fall 2015

The optimization of two changing landscapes, Landau free energy density and Rastrigin function, is performed using genetic algorithms (GAs) with genotype–phenotype (GP) mapping. Theoretically, the structures of genotype and phenotype spaces determine the searching ability of a GP map, causing fundamental effects on the GAs' performance. To ensure chromosomes (walkers in a genotype space) occupy the beneficial subspaces with regard to GP mapping, structure-oriented strategies for evolution are necessary. Thus, an elementary version of decentralized mutation only GA is proposed here. This first version is still imperfect and requires further improvement. However, this vision can be considered a prototype for integrating self-adaptive GA and GP mapping.

Advisor: SZETO Kwok Yip / PHYS
Student: DING Mucong / SSCI UROP Course: UROP1000, Summer 2016

In this paper, we investigate the first-passage process of random walks on complex networks and derive an exact formula for the first-passage probability between two nodes at a given time. The formula is written as the summation of several finite terms with different frequencies corresponding to the poles of transformed function and separating the short- and long-term behaviors of the first-passage process. We give a formula of the decay rate β, which is inversely proportional to the characteristic relaxation time τ of the target node. We also introduce mean-field approximation methods to estimate the characteristic relaxation time τ. The numerical simulations of random walks on artificial and real networks validate the analytical predication.

Advisor: SZETO Kwok Yip / PHYS
Student: WANG Juntao / PHYS UROP Course: UROP1100, Summer 2016

A financial bank system is associated with the money flow inside a bank network, the interaction between banks may always not be bidirectional, such that using directed network to represent the connection between banks is preferable. In financial bank systems, network stability is a significant feature, which we have analyzed. If banks are driven into bankruptcy, the entire financial system is greatly affected. The stability differs among various network connections. Thus, in this paper, we analyze the relationship between the topological characteristics and stability of a bank network. Moreover, we use a random walk model and PageRank algorithm to investigate the stability of the bank system and use the Erdös–Rényi (ER) network to simulate interlinks inside a financial bank system.

Sequence Analysis in Multi-agent Games

Advisor: SZETO Kwok Yip / PHYS
Student: LAU Ka Ki / PHYS UROP Course: UROP1100, Spring 2016

The phenomenon Parrondo's paradox suggests that individually losing strategies can be mixed and played in a specific sequence to produce a winning result. In this report, I introduce studies related to this topic in the UROP

project that I conducted in the past 3 months. By using both numerical simulation and mathematical means, I investigated a simple modified version of Parrondo's games, which are games that switch winning probabilities periodically, with a focus on the 1A2B, 1A3B, and 2A1B sequences of the original Parrondo's games. The results showed that among the three sequence patterns in the original Parrondo's games, all of which show the Parrondo's effect, 1A2B led to the largest winning effect, followed by 2A1B and then 1A3B.

Advisor: SZETO Kwok Yip / PHYS
Student: NG Yan Ho Matthew / PHYS UROP Course: UROP1100, Spring 2016

Genetic algorithms (GAs) have been used to reconstruct randomized networks and solve single equations with multiple unknowns. This study searches for efficient GA methodologies to tackle problems beyond simple function optimization. Edge redistribution and node indexing permutation was performed to reconstruct a perfect Watts–Strogatz network. The permutation was also used to solve a single equation with multiple unknowns. The effects of a reducing solution space were investigated to explore possibilities of efficiency improvement. Network reconstruction by the preceding methods was not satisfactory because only partial reconstruction could be achieved; nevertheless, the single equation with multiple unknowns could be solved using permutation, The number of iterations required to obtain a valid solution for the reduced solution space was not smaller than that for the original solution space for both 2D functions with multiple minima and the single equation with multiple unknowns.

Topology and Reliability of Networks

Advisor: SZETO Kwok Yip / PHYS
Student: BU Qi / PHYS-PM UROP Course: UROP1100, Fall 2015

The average communicability indicates whether the nodes of a network are well correlated with each other. According to the definition, the average communicability of a network is related to its eigenvalues and eigenvectors. If two networks have the same number of vertices and the same number of edges, we may identify the one having larger average communicability by comparing the eigenvalues and eigenvectors of the two networks. The relationship between the average communicability and the variance of the degree of nodes was also studied, and they were found to be positively correlated.

Advisor: SZETO Kwok Yip / PHYS
Student: CHAN Zhao Cong / PHYS-IRE UROP Course: UROP1100, Spring 2016

This report describes the information and data I have collected in the past semester concerning the UROP project. An introduction to the topic of networks is provided in the beginning. Analytical problems and numerical problems solved in this semester are explained in detail. The problems include finding the number of triangles in a given undirected network, finding the total number of edges and clustering coefficient of a perfect Watts–Strogatz network with a given number of nodes N and number of layers R, and rearranging the labels of an adjacency matrix to achieve certain goals. Complete solutions are provided for analytical problems, and graphs are provided for simulation problems.

Advisor: SZETO Kwok Yip / PHYS
Student: LUK Patrick Wan-hin / PHYS UROP Course: UROP3100, Spring 2016

Different networks structures are used in different networks for varied applications. Some network structures are the most suitable for some applications but unsuitable for others. Genetic algorithms are algorithms that search for locally optimized solutions under certain constraints, similar to natural selection occurring in the real world. By varying the constraints, different optimized network structures can be discovered for different applications. Genetic algorithms can also be used to identify nearly isomorphic networks by swapping labels names of nodes and finding the most suitable match adjacency matrices.

Keywords—adjacency matrix, clustering coefficient, fitness, genetic algorithm.

Advisor: SZETO Kwok Yip / PHYS
Student: CHENG Man Hin / PHYS UROP Course: UROP1000, Summer 2016

For a random resistance network, equivalent resistance can be measured easily through experimentation, but this becomes difficult in theoretical calculations. In this report, a complicated resistance network is first simplified using two algorithms. A few resistance networks are resolved using Kirchhoff's rule, as a motivation for further research on this topic. Finding the equivalent resistance theoretically can reduce the time and effort required for constructing the circuit and may aid in creating a resistant network for a more suitable product design, thus potentially benefitting engineering applications.

Quantum Oscillations in Low Dimensional System

Advisor: WANG Ning / PHYS
Student: IYER Aditya Varna / PHYS-IRE UROP Course: UROP1100, Summer 2016

In this report, we investigate the Landau diamagnetism of an electron gas in a 2-dimensional plane confined by a harmonic oscillator potential in the z direction, under the influence of a magnetic field perpendicular or parallel to the plane.

Advisor: WANG Ning / PHYS
Student: SUN Yusen / SSCI-IRE UROP Course: UROP1000, Summer 2016

Quantum oscillation is an experimental technique for mapping out the Fermi surface of a conducting low-dimensional material. Furthermore, quantum walk is a quantum algorithm that can simulate quantum oscillations. Quantum walk is a unitary time-evolved transformation: Similar to classical random walk, quantum walk shifts to the selected neighboring position after a random-selection process (e.g., flipping a coin). However, for quantum walk, both position and the "coin" can evolve with time, and different possible paths can interfere with each other causing constructive or destructive interference. To derive the evolution of quantum walk, some mathematical tools are required, such as Dirac notation, tensor product, and Schrödinger picture, which are discussed in the article.

Advisor: WANG Ning / PHYS
Student: WU Dake / SSCI UROP Course: UROP1100, Summer 2016

This report describes the basic mechanism of quantum walk along with some fundamental analyses on the periodicity of the walk on a cycle.

Advisor: WANG Ning / PHYS
Student: YU Yue / PHYS-IRE UROP Course: UROP1100, Summer 2016

We studied the evolution of an initially delocalized ground state of quantum walk on a finite wire under a periodic small increment of vector potential. We observed that the intrinsic oscillation of the two topologically protected bound states, which were the Majorana modes, is enveloped by a periodic oscillation controllable by the incremental vector potential α. The interaction between two topologically protected bound states was exactly calculable for the quantum wire and depended only on the inertial parameter θ in the coin matrix and the length of the wire. This interaction energy determining the intrinsic oscillation between the two ground states had a distinguishably long period. By tuning an external magnetic field corresponding to the addition of a small α impulse at the end of each intrinsic period, the system could be reduced to an approximately two level system, thereby inducing a beat oscillation between these two ground states, which was computable. The beat oscillation aided in determining the delocalized ground state, with possible application to the preparation of a decoherence-free qubit in a trapped ion chain.

Photoexcited Charge Generation and Recombination Dynamics in Perovskite Solar Cells

Advisor: WONG Kam Sing / PHYS
Student: CHOW Kai Lin / PHYS UROP Course: UROP1000, Summer 2016

The perovskite solar cell manufacturing technology was conceived as the rising star of the modern photovoltaic technology, with its advanced development within a short period. This research aimed is to study the photoluminescence and photoexcited carriers lifetimes of the 2D perovskites. The results indicated that the peak intensity shifts to longer wavelengths and the photoluminescence lifetime lengthens, with the increase in the number of layers of the samples, as a result of the quantum confinement effect. Hence, according to a corollary, the band gap decreases, whereas the diffusion length enhances as the sample consists of more layers.

Advisor: WONG Kam Sing / PHYS
Student: CHOW Tsz Pong / PHYS UROP Course: UROP1000, Summer 2016

The optical and optoelectronic properties of lead halide perovskite nanocrystals have been studied in recent years. Because the material has a tunable band gap and bright photoluminescence, the material has drawn increased attention. Specifically, the nanocrystals of cesium lead halide perovskite ($CsPbBr_3$) demonstrate photoluminescence and amplified spontaneous emission. In our experiment, by laser exciation with different wavelengths to the nanocrystal and increasing incident laser intensities, we observed and verified the amplified spontaneous emission of this particular nanocrystal. In previous studies, although the solution and powder forms of the nanocrystal on a thin glass have seen optical pumped lasing, in our experiment, only the photoluminescence of the material was observed.

Advisor: WONG Kam Sing / PHYS
Student: NG Wai Kit / PHYS UROP Course: UROP1000, Summer 2016

Organic–inorganic halide perovskites are used in the fabrication of solar cells because of their strong light harvesting property. Triiodide perovskite ($MAPbI_3$) is one of the most studied perovskited materials. In addition, MAPbSnI is another type of perovskite showing a tunable light band gap, but less information is available on this perovskite. Here, we studied MAPbSnI perovskites by using the steady-state photoluminescence (PL) and time-resolved photoluminescence (TRPL) spectroscopy; the transition was observed in charge carriers at 850 nm. Charge carrier lifetime in 850-nm transition was also measured. PEDOT:PSS-deposited MAPbSnI show a much shorter lifetime in TRPL measurement. Because of its effective PL quenching, PEDOT:PSS became a suitable candidate in the hole extracting layer on perovskite solar cells.

Space Orbit Design

Advisor: WONG Michael Kwok Yee / PHYS Co-advisor: CHAN Kwing Lam / MATH
Student: SHING Ming Tony / PHYS-IRE UROP Course: UROP3100, Fall 2015

While designing a space program, the spaceship is often required to visit more than one target. The sequence of visiting different targets determines how well the mission can be accomplished within a limited time and fuel usage. To find the most suitable trajectory, the position and orbit of the set of possible targets must be considered to determine the most suitable or relatively suitable trajectory by using different algorithms. This semester, I conducted a project in ESA called the active space debris removal project. An approximation program and a basic searching program were developed in a Python environment.

Advisor: WONG Michael Kwok Yee / PHYS Co-advisor: CHAN Kwing Lam / MATH
Student: LAU Albert Wai Kit / PHYS UROP Course: UROP1100, Fall 2015
UROP2100, Spring 2016

For many space programs, searching for the most appropriate route is required to achieve the mission aim, consume less fuel, and reduce costs. In the previous two semesters, I investigated the space debris removal problem and designed a few algorithms to search for the most appropriate route for space debris removal by using existing data.

Advisor: WONG Michael Kwok Yee / PHYS
Student: CHEUNG Yik Kin / SENG UROP Course: UROP1000, Summer 2016

This report describes a modified N-body propagator applicable to a solar sail spacecraft by changing the model used for calculating acceleration due to solar radiation pressure (SRP), which is the source of momentum gain of a solar sail propulsion method. With SRP, the acceleration vector can be pointed parallel to the incident light from the sun to the spacecraft or to the normal vector of the solar sail. A detailed model for SRP can be used to evaluate and analyze the trajectory of a spacecraft containing a solar sail propulsion system for mission design purposes.

Advisor: WONG Michael Kwok Yee / PHYS
Student: NG Yat Hei / SSCI-IRE UROP Course: UROP1100, Summer 2016

The purpose of this project is to investigate the potential use of halo orbits in space exploration. The project focuses on transferring a spacecraft into halo orbits of the second Lagrange point 2 in the Earth–Moon system. The potential application of L2 halo orbits in the Earth–Moon system is discussed, and the modeling of the transfer trajectory halo orbits is examined by matching patched-integrated trajectories. The efficiency of the pair matching of the forward and backward trajectories is also discussed.

Advisor: WONG Michael Kwok Yee / PHYS
Student: YAU Wan Yee / SSCI UROP Course: UROP1100, Summer 2016

Designing a space orbit typically requires acquiring an optimal sequence. A suitable trajectory should have a short time of flight and low fuel consumption to reduce the mission cost. Different searching algorithms can be used to find the optimal sequence efficiently. Different algorithms should be applied to search for sequences, and the resulting sequences should be compared with those found using other algorithms to acquire the optimal trajectory. In this project, I studied the asteroid billiard problem released by the Global Trajectory Optimisation Competition. The search for the sequences in this problem was done in a Python environment.

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SCHOOL OF ENGINEERING

Department of Chemical & Biomolecular Engineering

Green Processing of Seafood Shell Waste

Advisor: HUI Chi Wai / CBME
Student: ELVINA Jesslyn / CEEV UROP Course: UROP1000, Summer 2016

Seafood, specifically shrimp, is constantly in high demand because of its high protein content. Shrimp waste contains bioactive compounds, such as amino acids, minerals, chitin, and pigments. However, the current chemical processes of shrimp waste treatment use chemicals harmful to the environment and bioactive compounds. This project aims to investigate the optimum conditions of processing shrimp shells to recover valuable bioactive compounds, while focusing on the recovery of chitin and the red pigment astaxanthin. Solvent extraction studies indicate that methanol is the organic solvent that can extract the most astaxanthin from shrimp waste. Extraction at the boiling point of methanol for 6–12 h could yield the largest amount of the pigment; a high shrimp-to-solvent ratio (50 mg:1 ml) may improve extraction yield.

Advisor: HUI Chi Wai / CBME
Student: HO Cheuk Hei / SENG UROP Course: UROP1000, Summer 2016

Shrimp is a popular seafood and therefore shrimp waste, comprising 40% protein, 35% minerals, and 14%–30% chitin (Synowiecki and Al-Khateeb, 2000), can be easily collected and used to produce chitosan, a valuable polymer, through appropriate chemical procedures—deproteination, demineralization, and deacetylation. In the traditional method of chitosan production, shrimp are bleached using acidified hydrogen peroxide without recovering the pigments, thus wasting resources. This report focuses on the optimization of shrimp shell decolorization. Our solvent extraction results indicated that methanol and acetonitrile have the highest and lowest pigment extraction abilities, respectively, and that the most favorable solvent-to-powder ratio and heating time are 1 mL:50 mg and ≤6 h, respectively.

Production of Furfural from Xylose by Niobium-based Catalysts

Advisor: LAM Leung Yuk Frank / CBME
Student: CHAN Hiu Yin / CBME UROP Course: UROP1100, Fall 2015

The demand for furfural has increased substantially because of its numerous applications, particularly on the intermediates of furan-based chemical synthesis. Furfural can be obtained through dehydration of xylose, which is a main component of hemicelluloses. Experiments were designed to optimize the yield, conversion, and selectivity of the xylose-to-furfural reaction with fly ash as a catalyst. The optimal reaction time and temperature ranges were found to be was 3–4 h and 170°C–200°C, respectively; however, no conclusion was drawn after varying the xylose-to-catalyst ratio. Another catalyst, MOF, is under economic analysis for constructing a continuous process. The evaluation on the cost of raw materials and products has been completed. Moreover, a flow diagram has been constructed as a basis to further investigate the specifications of operating units and balances on material and energy.

Keywords—xylose, furfural, MOF, heterogeneous solid acid catalyst, dehydration, continuous process.

Advisor: LAM Leung Yuk Frank / CBME
Student: GOH Jiajie / CEEV UROP Course: UROP1100, Fall 2015

Because of the declining supply of nonrenewable resources, an energy crisis has become a major public concern over the past decades. A wide range of well-developed renewable resources are now available; of these, lignocellulosic biomass, which can be converted to furfural, has gained particular attention because of its abundance and wide industrial applications. Furfural, derived from xylose is commonly used in plastic manufacturing, oil refining, and synthesis of furan derivatives, such as tetrahydrofuran and furfuryl alcohol.

Furfural is produced in a two-step process—hydrolysis of pentosan followed by dehydration of xylose in the presence of an acid catalyst. In the dehydration process, compared with a heterogeneous acid catalyst, homogenous acid catalyst is used more extensively because its preparation is simpler and easier. However, the homogeneous catalytic process is unsustainable because it tends to create waste and is difficult to be reused. Therefore, the development of a heterogeneous, preferably metal-based, catalyst is required to replace homogeneous acid catalysts.

In this experiment, the effects of using different types of metal catalysts (Ni, Fe, Zn, Cu, Nb, and Zr) on the production of furfural from xylose will be investigated.

Adhesives from Dandelions

Advisor: LUO Zhengtang / CBME
Student: ZU Yuexuan / CENG UROP Course: UROP1100, Fall 2015

Because petroleum is becoming increasingly scarce, the production of synthetic rubber- and resin-based adhesives will soon encounter a shortage of raw materials. Therefore, this study aims to develop and analyze a process to produce adhesive from Russian dandelions (*Taraxacum kok-saghyz*). The present report first discusses the current mismatch between the supply and demand of rubber-based adhesives and then argues for the suitability of Russian dandelions as an alternative source of rubber. The current approaches for rubber-based adhesive production are then analyzed and compared and an alternative approach is proposed. The report further examines the process economically by calculating its profitability.

Advanced Catalysts for Water Splitting and Hydrogen Production

Advisor: SHAO Minhua / CBME
Student: YUDIANA Nadiya Aisha / CHEM UROP Course: UROP1100, Fall 2015

As an ideal energy carrier, hydrogen has been considered a potential major energy resource for the future. This project aims to produce hydrogen from water splitting by synthesizing affordable nonprecious metal-based catalysts for use in hydrogen evolution reaction. N-doped carbonaceous materials containing nonprecious metals were used in the experiment to identify an alternative to platinum, one of the most highly efficient catalysts; however, this process had high production costs. This report explains the experimental procedures of material synthesis of the catalysts, their pretreatment, and electrochemical tests for catalytic activity. Characterization techniques, such as X-ray photoelectron spectroscopy and X-ray diffraction, were applied to verify the substances or constituents of the catalysts.

Advisor: SHAO Minhua / CBME
Student: WANG Ta-wei / SENG UROP Course: UROP1100, Summer 2016

Currently, the kinetics of a hydrogen evolution reaction (HER) catalyzed by an electrochemical catalyst in an alkaline medium is very slow. A newly proposed solution for this issue is alloying the catalyst with oxophilic metals, such that the H_{ad} intermediate would be removed through a reaction with OH_{ad}. Here, we focused on a binary PtRu alloy loaded with carbon with different molar ratios of Pt-to-Ru. To reduce factors affecting the performance of the catalysts, we maintained the electrocatalytic surface areas of all catalysts to be similar through CO stripping. We observed that Pt_3Ru/C had the highest electrocatalytic activity in both acid and alkaline media. In the presence of Ru, PtRu/C demonstrated higher activity in the alkaline medium than did Pt/C. These findings increase our fundamental understanding of HER catalysts.

Catalysts for Direct Ethanol Fuel Cell

Advisor: SHAO Minhua / CBME
Student: HAN Eunhye / CHEM UROP Course: UROP1100, Spring 2016

This report describes a new metal deposition method, resembling Au@Pt core-shell electrocatalysis; it involves deposition of a mixed monolayer or submonolayer comprising Pt and Ru atoms on Au nanoparticle surfaces by using a Cu monolayer as a template. Pt and Ru deposition occurs as a spontaneous irreversible redox process, in which a Cu monolayer, obtained through Cu underpotential deposition, is oxidized by more noble metal cations, followed by reduction and simultaneous deposition of metal atoms. The Pt-Ru mixed shell supported on Au demonstrates much higher ethanol oxidation activity than does commercial Pt/C.

Keywords—electrochemical methods, electrodeposition, surfaces, platinum, ruthenium.

Advisor: SHAO Minhua / CBME
Student: SULAIMAN Jordy Evan / CBME UROP Course: UROP1100, Summer 2016

Platinum (Pt) is a catalyst most commonly used in direct ethanol fuel cells; alloying platinum with another metal is essential for overcoming the limitations of Pt, such as CO poisoning and low CO_2 selectivity. Nanoscale Pt−Ni alloy octahedra with only {111} exposed facets have been examined in recent years, owning to their exceptional activity in the oxygen reduction reaction. Here, we report the synthesis of Pt–Ni alloy octahedra with an average particle size of 10 nm by using oleylamine and oleic acid as surfactants. The electrocatalytic activity of Pt-Ni octahedra was verified, and the results revealed that the activity and durability of Pt–Ni octahedra is superior to the conventional Pt–Ni alloy and commercial Pt particles.

Air Quality Survey at Various Sites in Hong Kong

Advisor: YEUNG King Lun / CBME
Student: WONG Cheuk Pan / CHEM UROP Course: UROP1000, Summer 2016

Currently, malodor—mainly containing ammonia, hydrogen sulfide, and volatile organic compounds—is a serious concern in Hong Kong. The decay of nitrogen compounds is the source of ammonia, and the anaerobic decomposition of organic compounds by bacteria produces hydrogen sulfide. Malodor gas emission is smelly and affects public health and environment; for instance, at high concentrations, hydrogen sulfide can cause conjunctival irritation and even loss of smell.

In this experiment, multifunctional gels through direct mixing and the gel-in-place method is applied to reduce the malodor in the sludge. The malodor can be reduced by inhibiting microbial activity with reactions and absorption of hydrogen sulfide, along with the release of active components and antimicrobial reagents.

Bioactivity of Indoor Dust and Particulates

Advisor: YEUNG King Lun / CBME
Student: KIM Solin / CBME UROP Course: UROP1100, Summer 2016
Student: SAMIN Felicia / CEEV UROP Course: UROP1000, Summer 2016

Dust and particulates in indoor environments contain various chemical compounds originating from various household products. Furthermore, the widespread use of disinfectants in many household cleansers increase the risks of having unwanted reactions with dust and particulate matters resulting in toxic byproducts. This project aims to measure the bioactivity of dust and particulates collected in indoor offices and investigate its effects on living organism postreaction with common household disinfectants.

Microbial Disinfection Technologies in a Hospital Setting

Advisor: YEUNG King Lun / CBME
Student: CHAN Shek Nga / SENG UROP Course: UROP1000, Summer 2016

This study aims to develop a novel antimicrobial coating for disinfecting fabric surfaces in hospital settings by using polyethylenimine (PEI) and polyhexamethylene biguanide (PHMB) to combat hospital-acquired infections; the coating must have sufficient bactericidal properties and low cytotoxicity. In this study, formulations with PEI and PHMB at different ratios were tested for cytotoxicity and bactericidal properties. In vitro cytotoxic effects were measured using MTT assay on MDCK, A431, and A549 cells. The bactericidal properties were quantified using bactericidal test with gram-positive and gram-negative bacteria. The proposed low-concentration high-molecular-weight PEI formulations highly diluted with polyvinyl alcohol demonstrated favorable bactericidal properties and low cytotoxicity.

New Technologies Against Malodors

Advisor: YEUNG King Lun / CBME
Co-advisor: HAN Wei / ENVR
Student: LI Cheuk Yin / CBME
UROP Course: UROP1000, Summer 2016

The sewer and drainage system generates malodor that can affect people's standard of living. This malodor, generally comprising hydrogen sulfide (H_2S), ammonia (NH_3), and volatile organic compounds, is toxic and can have adverse effects on the environment. H_2S is generated anaerobically by sulfate-reducing bacteria, and NH_3 originates from organic matter. Treatment plants treat wastewater by using several processes, transforming it into clean water. However, the treatment does not effectively reduce the malodor of the sludge, which is a byproduct of the treatment. This experiment applies hydrogel with a few antimicrobial compounds as an antimicrobial to suppress the activities of sludge microorganisms that cause malodor. The hydrogel enables a controlled release of the antimicrobial compounds to increase their effective time of microbial suppression. The effectiveness of the gel will be examined with the sample provided by the drainage services department.

Pulsed-Electric Field Device for Point-of-Use Water Disinfection

Advisor: YEUNG King Lun / CBME
Student: WIHARDJO Nathaniel / SENG
UROP Course: UROP1000, Summer 2016

This project aims to develop a device based on the pulsed-electric field (PEF) mechanism for water disinfection. A combination of two membrane types, PVDF and stainless steel, were used as the cathode. The use of three membranes with the stainless steel membranae placed between two PVDF membranes resulted in more favorable filtration performance compared with the use of only two membranes. Parameters, such as input voltage, flow rate, water source, bandwidth, and frequency, were varied to determine the performance of the device. The results demonstrated that the variation in the parameters did not affect the performance. To measure the reduction rate and efficiency of the device, *Escherichia coli* was used. The device will be useful for disinfecting tap water in various cases.

Department of Civil & Environmental Engineering

Nanotechnology for Water and Wastewater Treatment

Advisor: LO Irene Man Chi / CIVL
Student: MAO Yun-wen / SSCI UROP Course: UROP1000, Summer 2016

Phosphate is frequently used in agriculture as fertilizer. However, it is also commonly found in wastewater. Excessive presence of phosphate in the natural environment causes catastrophic consequences such as eutrophication. Thus, this paper proposes a solution for removing and recycling phosphate in wastewater by using a noble magnetic nanoparticle ZrO_2@SiO_2@Fe_3O_4. The research focuses on identifying the efficiency of the particle under different conditions: (i) by using synthesized wastewater, only containing phosphate and deionized water, and (ii) using actual wastewater collected from Stonecutters Island Sewage Treatment Works, Hong Kong. The results show that even when the particle is applied to real wastewater, the particle performs with high adsorption and desorption efficiencies of 99.1% and 71.2%, respectively.

A Big Data Architecture and Machine Learning Initiative for Real-time Landslide Monitoring and Early Warning System

Advisor: WANG Yu-Hsing / CIVL
Student: HO Chun Tak / CIVL UROP Course: UROP3100, Fall 2015

Big data—primarily a complex and large data set that renders conventional data processing inadequate—will now be introduced to geotechnical engineering. This innovative application will provide researchers an excellent opportunity to review and improve traditional geotechnical science and overcome great challenges. The concept of big data has been introduced because a large amount of raw data is produced by microelectromechanical systems' accelerometers at nearly 4 Mb/s, a massive and unprecedented speed compared with experimental data, in conventional geotechnical science processes. This progress report will show (1) how the computation of the raw data can finally be developed into self-improving real time landslide predictions and warning systems, (2) how the concept of big data and machine learning can be applied to geotechnical science by using the software Python, and (3) future developments and improvements in this project. With successful development of this real-time system, a more powerful and quicker response and low monitoring cost approach in landslides monitoring and early warning system can be expected.

Advisor: WANG Yu-Hsing / CIVL
Student: LI Mengyuan / CIVL UROP Course: UROP2100, Spring 2016

Landslides are hazardous, with their time and location of occurrence and affected area being difficult to predict thus far. Studies have demonstrated that the incidence of landslides is related to geological causes, such as rainfall and groundwater, as well as morphological and physical causes, of which some can be potentially detected using sensors. In this project, efficient and lower cost sensors are applied as scalable systems in Hong Kong and Taiwan to transmit information and store it in a database, ready for analyzing in real-time. In addition, to efficiently analyze the massive amount of information, a big data structure with a machine leaning process is required. Thus, the system trained using this data can have improved correctness of judgment and predict a landslide more accurately.

A Big Data Landslide Early Warning System with Apache Spark and Scala

Advisor: WANG Yu-Hsing / CIVL
Student: CHANG Bing An / SSCI UROP Course: UROP1000, Summer 2016
Student: NG Zhi Yong Ignavier / SENG UROP Course: UROP1000, Summer 2016
Student: THAM Brendan Guang Yao / SENG UROP Course: UROP1000, Summer 2016

Student: WONG Wen Yan / SENG UROP Course: UROP1000, Summer 2016

In recent years, big data analytics is a new approach, through which researchers and companies are conducting experiments and analyses, particularly in the field of seismic monitoring, where it is being initially used for landslide monitoring through a large-scale deployment of sensors (*Ooi et al. 2016*). Because this project analyzes inconsistent, unstructured metadata, a new suitable data management system needs to be constructed. This report provides an overview of popular data management conventions and the reasons it does not suit our requirements. Subsequently, we introduce a new data management format, called metadata event log, complemented by functions written in Apache Spark and Scala to access and return the correct set of data. Finally, we discuss lessons we learned during the course of the project and potential future developments.

Advisor: WANG Yu-Hsing / CIVL
Student: LIU Kuan-fu / ELEC UROP Course: UROP1000, Summer 2016

A landslide is a form of ground movement resulting from gravitational force and soil conditions. Although considered natural disasters, landslides are often aggravated by human activities, such as misuse of land or excessive development, leading to severe economic loss and even casualties without proper precautions and prompt action. This project aims to design a sensor system that collects real-time data from areas that are potentially hazardous to unfavorable land movements; the collected data are further analyzed to monitor the surroundings as well as to predict the occurrence of landslides, setting up an early landslide warning system. In particular, this project aims to study the hardware design of such a sensor system, particularly in the design of electronic circuitries and the layout of printed circuit boards.

A Data-Driven Approach for Real-time Landslide Monitoring and Early Warning System

Advisor: WANG Yu-Hsing / CIVL
Student: LAI Yong Xin / SENG UROP Course: UROP1000, Summer 2016

In recent years, big data analytics is a new approach, through which researchers and companies are conducting experiments and analyses, particularly in the field of seismic monitoring, where it is being used for landslide monitoring through a large-scale deployment of sensors (*Ooi et al. 2016*). Because this project analyzes inconsistent, unstructured metadata, a new suitable data management system needs to be constructed. This report provides an overview of popular data management conventions and the reasons it does not suit our requirements. Subsequently, we introduce a new data management format, called metadata event log, complemented by functions written in Apache Spark and Scala to access and return the correct set of data. Finally, we discuss lessons we learned during the course of the project and potential future developments.

Coping with Landslide Risks under Extreme Storms in the Changing Climate

Advisor: ZHANG Li Min / CIVL
Student: JAP Jessica / SENG UROP Course: UROP1000, Summer 2016

Landslide disasters occur frequently throughout the world, with some causing more fatalities and damage to the affected areas than others. However, the global occurrence of fatal landslides has not been thoroughly recorded and compiled in a single database, where it includes parameters of the landslide and the vulnerability. Although some extremely fatal landslides have been assessed individually and papers regarding these are widely available, data on numerous landslide events are necessary to determine the trends in location and triggering mechanisms, and most importantly, to quantify the vulnerability to landslides. Therefore, a global database of fatal landslides was compiled by studying past fatal landslide events published in the news, research papers, and websites (both official and unofficial); the compilation in a single Excel file includes landslide information, such as date,

geographical location, area of landslide, elevation, triggering mechanisms, fatalities, and damage. This landslide inventory is a crucial source for analyzing landslide occurrence trends, as well as the relationship of travel distance, volume, and area of the landslide with the number of fatalities and affected people by using a regression model formed in the database.

Determination of Permeability in Porous Media

Advisor: ZHAO Jidong / CIVL
Student: LI Meibai / CIVL UROP Course: UROP1100, Spring 2016

Permeability is a major property of porous media. Numerous studies have been conducted for analyzing the influencing factors and proposing models to estimate permeability. This article provides a literature review in which several relevant models, categorized by research methods, are briefly introduced, followed by a discussion of these models at the end.

Department of Computer Science & Engineering

Indoor Localization and Mobile Computing

Advisor: CHAN Gary Shueng Han / CSE
Student: HUANG Kung-hsiang / COMP UROP Course: UROP1100, Fall 2015

The advances in Wi-Fi technology have resulted in the increasing ubiquity of wireless networks. Wi-Fi signals are commonly received through devices, such as laptops and smartphones, in universities, business building, and public places. In such environments, users can select any of the various access points (APs); this determines their experience of the service provided by a network. Consequently, affiliating a smartphone to an optimal AP has become a major issue. The current AP connection mechanism mainly depends on received signal strength indication (RSSI) in some existing products, which is unreliable. This project aims to resolve this issue by applying a more intelligent algorithm to an app. In the subsequent paragraph, this report discusses the development procedure and result of this project.

Advisor: CHAN Gary Shueng Han / CSE
Student: ZHANG Ziyao / COMP UROP Course: UROP1100, Spring 2016

Considered a great opportunity to enrich college life, the Undergraduate Research Opportunities Program (UROP) provided me a great chance to broaden my horizon in the discipline of computer science and develop my ability of writing mobile programs. This was the first time I was exposed to a research and development environment. Throughout the semester, I spent most of the time self-learning mobile programming skills and read some files related to indoor localization technology. In the second half of the semester, I participated in a data collection session. Although my participation and contribution to the project was minor, I was highly benefited by the UROP; this program was a vital part of my undergraduate life.

Keywords—mobile application programming, self-learning, paper reading, data collection session.

Advisor: CHAN Gary Shueng Han / CSE
Student: ZHU Xinyu / COMP UROP Course: UROP1100, Fall 2015
UROP2100, Spring 2016

In this report, we introduce a new method to track a group of moving targets by combining GPS technology and the received signal strength indicator (RSSI), considering the error introduced by both of them. The traditional triangulation localization method requires an extremely accurate distance between the target and the detector, which is typically difficult to measure because of the noise in the RSSI. In our system, a group of detectors, the position of which is provided by GPS, will detect the signal from an unknown target and provide a vector of the RSSI value. Each position and RSSI value contains some error, with a distribution that can be measured beforehand. Thus, we can adjust the RSSI in each vector, such that their value becomes closer to the real value; based on this, we can calculate the distance.

Advisor: CHAN Gary Shueng Han / CSE
Student: CAI Haoye / COMP UROP Course: UROP1100, Spring 2016
UROP2100, Summer 2016

Nowadays, with the rapid development and increasing usage of mobile devices, such as smartphones and tablets, the demand for localization services is increasing. Consequently, various localization techniques have been developed, the most well-known of which is GPS localization. However, because its range is small, more accurate methods must be used for indoor localization, with Wi-Fi signal RSSI being one of them. A critical step in indoor localization is the prediction of RSSI for some unknown positions (also called fingerprints) on the basis of some known training data (i.e., a fingerprint database updated using Gaussian process regression). Here, we

implemented and ran this algorithm in Python to test its feasibility. In this report, we will elaborate on the implementation in detail and present some results obtained on the basis of some data collected on-site.

Large-scale Multimedia Streaming Technologies in the Mobile Internet

Advisor: CHAN Gary Shueng Han / CSE
Student: BAI Chunyan / COSC UROP Course: UROP1100, Fall 2015
Student: TIAN Xinran / COSC UROP Course: UROP1100, Fall 2015

Streaming media production is an excellent technology used worldwide. It starts with infinite information in the real world from various sources (e.g., lenses of camcorders), and ends with tightly compressed files necessary for streaming delivery. During the process, the information is digitized, encoded, reencoded, and frequently transcoded. Transcoding is one of the most significant procedures in streaming technology. Our research is conducted for making the most use of a given transcoding software by adding functions and making modifications to it.

Video Cloud and Data Center for Pervasive Streaming

Advisor: CHAN Gary Shueng Han / CSE
Student: CHIU Ho Tin / COMP UROP Course: UROP1100, Spring 2016

The purpose of this study is to observe how WebRTC peers can connect with each other. Connecting two peers can be easy to perform, with several examples available on the Internet; however, connecting three or more peers can be difficult. This report describes the methodology of connecting peers; first, the method of connecting two peers is discussed, followed by the extension of its features and then an effective and flexible method for connecting multiple peers. The ability to form connections with multiple peers may be crucial in the development of future WebRTC applications.

Advisor: CHAN Gary Shueng Han / CSE
Student: DU Xinnan / COMP UROP Course: UROP1100, Spring 2016

Online video cloud is currently a topic great interest. With the advanced technology of network and cloud, videos can now be delivered to users at a relatively faster speed. HKUST multimedia laboratory currently has a close cooperative relationship with China Mobile on video cloud research, and the UTV mobile app is one of their collaborative projects. The UTV app provides a platform for users to watch high-quality live-streaming videos by using the back-end cloud. The mobile app is a good innovation; however, with the advancement of web technology, mobile web apps are becoming increasingly popular; they can be accessed everywhere and are easily customizable with cost-effective development. Thus, our project aims to transfer the UTV app platform from mobile to web. By using a responsive web design, the app can be customized to suit different devices and provide similar functionalities to the original iOS app.

Advisor: CHAN Gary Shueng Han / CSE
Student: SHANG Hang / CPEG UROP Course: UROP1100, Spring 2016

Synchronized video playback is a popular feature in today's video broadcast service. With the demands for better user experience increasing, synchronized video playback can enable users worldwide to enjoy video streaming simultaneously. This technique can have numerous applications, similar to the most famous popular live-broadcast apps (e.g., YouTube live and Twitch). In addition, this technique can have a great impact in many more areas.

Advisor: CHAN Gary Shueng Han / CSE
Student: WANG Yanzhao / COSC UROP Course: UROP1100, Spring 2016

With the development of network nowadays, video streaming and cloud technology is becoming pervasive. Online video conferencing, an application form of video streaming, plays a substantial role in our daily life, providing great convenience to human society. In this research project, my task is to setup servers supporting online video conference and determine the improvements required. My work mainly makes use of WebRTC, an application programming interface (API), which supports peer-to-peer real-time audio and video communications. By applying WebRTC, peer-to-peer video conferencing can be implemented on browsers and data transmission between end-users can be supported.

Advisor: CHAN Gary Shueng Han / CSE
Student: GANESH Vaishnavi / SENG UROP Course: UROP1000, Summer 2016

This entire project is centered on inserting advertisements into live video streams in real time. My contribution toward the project was to install an ad server for helping publishers and advertisers in terms of ad management, campaign management, and ad trafficking. I first collected data regarding various available ad servers. I selected the Revive Adserver mainly because it is open-source with a user-friendly interface and is licensed under the GNU General Public License. My research began by gathering information on Video Ad Serving Template (VAST), a standard that provides video players with information regarding ad insertion while watching a live video stream in real time. During the process, I learned that Revive Adserver does not support VAST 2.0 or VAST 3.0 for free. The VAST 2.0 support is available for Revive Adserver only through the Advanced Video Ads plugin, which is not open-source. Hence, rather than using VAST as a serving template, I focused on installing Revive Adserver on a Virtual Machine using CentOS 7.

Wi-Fi Tracking and User Analytics

Advisor: CHAN Gary Shueng Han / CSE
Student: HO Chun / COMP UROP Course: UROP1100, Spring 2016

Wherami is a project for indoor localization through WiFi-based location information and iBeacons for use in areas, such as HKUST and Harbor City. My tasks focus on developing and improving MapView in the main Wherami application, parsing and displaying useful information in the administrative application WiFi Collector, as well as producing a web-based HTML editor for the clients to easily create HTML pages to be placed in the WebView of the Android mobile application. Each task will be explained in detail in the report below. This will collectively improve the operation of Wherami and the subsequent developments.

Advisor: CHAN Gary Shueng Han / CSE
Student: KIM Zi Won / COMP UROP Course: UROP1100, Spring 2016

This report describes the project “Wi-Fi Tracking and User Analytics” and a student’s involvement. It first introduces what the project is about and what is being done to achieve the goal of the project. Because the entire project is large, this essay only focuses on a small portion of the project in which the student was involved. The report then elaborates on the part of the project the student participated in, with their role with regard to Android and iOS app development. It describes the student efforts to understand the Android app source code, followed by their progress in iOS app development for technology demonstration.

Advisor: CHAN Gary Shueng Han / CSE
Student: WU Yun-chen / COMP UROP Course: UROP3100, Spring 2016

Wi-Fi tracking is an efficient tool for indoor localization. Simultaneously, it is useful for analyzing a user’s behavior from the large amount of aggregated data. However, it can collect user information without prior consent; this has caused controversy regarding privacy leakage. To resolve the issue, some mechanisms should be applied to remove the MAC address, the unique identifier of devices, from the data set to database. One-way hashing is a technique by which the collected data no longer remains associated with the user, but the data can be differentiated from those of other users.

Advisor: CHAN Gary Shueng Han / CSE
Student: WANG Wenlong / SENG UROP Course: UROP1100, Summer 2016

Smart Wi-Fi algorithm is an indoor system that collects signals sent from a single smartphone device to different routers. By calculating the signal strength in different routers from the same device, we can detect the location of the device user. Thus, during an experimental period, we can analyze users' behaviors and some other factors, such as the population on a single floor, the most crowded period in a shop, or the relationship between a smartphone brand and shopping period in a single day. These results can be helpful and valuable in both research and commercial use.

Advisor: CHAN Gary Shueng Han / CSE
Student: ZHOU Yusheng / COSC UROP Course: UROP1000, Summer 2016

The emerging demand on indoor localization has necessitated relevant surveys and studies. Currently, people use either fingerprint-free or fingerprint-based schemes to achieve this target. However, although a set of models has been established for fingerprint-free approaches, it still may not function well in complex indoor environments, such as shopping malls. Thus practically, we will focus on the fingerprint-based schemes by using Wi-Fi as the carrier. In this article, we first introduce the fingerprint-based scheme, followed by how we achieve the fingerprint collection using mobile phone and access points, finally indicating some improvements to the current collecting scheme.

Spreadsheet Error Detection

Advisor: CHEUNG Shing Chi / CSE
Student: TSUI Kin Cheung / COMP UROP Course: UROP1000, Summer 2016

This UROP project focuses on spreadsheet error detection. Spreadsheets are widely used for data analysis and computation. Unlike conventional software, spreadsheets are typically developed and maintained by users who do not have computer science or programming training. Errors arise in spreadsheets when these users do not develop and maintain their spreadsheets disciplinarily. In this project, we conducted an empirical study of VEnron, which is a spreadsheet corpus extracted from the released data set by Enron in a court case. Spreadsheets in VEnron are grouped by means of their versions. The empirical study was to identify the major causes of errors in the VEnron spreadsheets. The empirical study results will enable us to explore if spreadsheet errors can be clustered and thereby formulated as patterns for automated spreadsheet error detection. This study was conducted using Custodies, which is a spreadsheet error detection tool developed by Prof. Shing Chi Cheung and his students. On completion of this UROP project, we found that there are four possible causes of spreadsheets smells. In addition, errors do not often evolve during spreadsheet updates. This suggests that spreadsheet users often perform very similar tasks when they update spreadsheets.

A 3D Scene Authoring Toolkit for Mobile Augmented Reality

Advisor: HUI Pan / CSE
Student: FU Shuhao / COSC UROP Course: UROP1100, Spring 2016

Augmented reality is a live view of our real, surrounding world augmented by software-generated input, such as graphics, sound, and GPS. This augmentation enables users to interact with the information regarding the physical world. As one of its most crucial branches, mobile-augmented reality applications have been a trend with the advancement of image processing technology and machine learning algorithms. Its potential applications in video gaming, industrial design, medicine, military, sports, and navigation has gained scientists' and engineers' attention. However, considering its time consumption and complexity, designing specific virtual 3D scene for each application is not affordable. In this work, we describe how to use TensorFlow, a powerful library, which aids in implementing and training deep neural networks, to build a relatively small convolutional neural network and then develop a scene authoring toolkit for augmented reality applications.

A Data-Mining-based System for Trip Planning

Advisor: HUI Pan / CSE
Student: WANG Ching-heng / COGBM UROP Course: UROP1100, Summer 2016

People's reliance on online social networks (OSNs), such as Twitter, has grown substantially in the past decade. With the increase in the use of these OSNs, the massive amount of user data generated provides great opportunities and resources for businesses to analyze users' behaviors and to extract useful information. This report discusses how the data from OSNs can be used in the media industry and introduces TrendWriter, a framework that detects trending topics in OSNs. Kwak et al. stated that more than 85% of the topics on Twitter become headline news articles and are discussed persistently. Thus, by analyzing the feeds on OSNs with our TrendWriter, news media can more accurately predict audiences' interests, consequently attracting more readers and increasing revenue. In conclusion, we include some technical aspects of TrendWriter and its advantages over traditional media.

Algorithms and Games in Android Devices

Advisor: HUI Pan / CSE
Student: HU Yao-chieh / COMP UROP Course: UROP2100, Fall 2015
Student: WANG Tianci / COMP UROP Course: UROP1100, Fall 2015

The goal of our project is to study and explore a game theory algorithm on Android devices. To accomplish this goal, we wrote an Android application for different cellphones to connect with each other and then built a network among the cellphones, on which we tested and ran the algorithm. On using the application, we adjusted the behavior of the network with the support of functions, such as scanning, connecting, sending, and receiving. Furthermore, by using java reflection library, we sent instructions from a sender device to a receiver device to invoke methods on the receiver and yield feedback to the sender device. The information was recorded in a database. Based on the currently built application, we anticipate more complex tasks to be distributed among devices and thus enable the investigation of game theory algorithms in the future.

Keywords—Wi-Fi direct connection, P2P technology, Android platform, file transmission.

Advisor: HUI Pan / CSE
Student: LIN Shuya / COGBM UROP Course: UROP2100, Fall 2015

Our team previously developed an Android application by using a relatively new short-distance communication and connection tool, Wi-Fi Direct. In this age where people compete for information and speed, connection protocols are of great significance for attaining and handling key information. Wi-Fi Direct, with a more portable and intuitive connection than Wi-Fi and hotspots, is safer and more user-friendly than other connection tools. It promises effortless connection with your Wi-Fi–enabled devices without disturbance with access points and lengthy passphrases. Therefore, our team probed further into the use of Wi-Fi Direct and modified the previous version of our application to make it a more useful and practical mobile application.

Advisor: HUI Pan / CSE
Student: LIU Boyu / COMP UROP Course: UROP2100, Fall 2015
Student: WENG Jiaqi / COGBM UROP Course: UROP2100, Fall 2015

Nowadays, people rely on Wi-Fi and RSSI to communicate with each other; thus, obtaining information of signal strength at different locations, helping the user make more favorable decisions about using Wi-Fi and RSSI, as well as helping the producer to improve their service. For this, we require a database to store the collected data for future use and review. Meanwhile, each device can be used to detect the signals; the data can then be collected and shared to obtain statistical information. This can be achieved using a Wi-Fi P2P connection in Android. By using Wi-Fi P2P, we can simply obtain, accumulate, and update each other's data. Therefore, we integrated these

factors to create an Android app, implementing the required functions. Basically, we detect Wi-Fi signals and store them in a database, then share them with other devices through Wi-Fi P2P. This may help a community know the information of Wi-Fi signals around them and thus benefit.

Advisor: HUI Pan / CSE
Student: MITTAL Akash / COMP UROP Course: UROP1100, Spring 2016

The project I worked on involved developing an algorithmic game theory implemented by a set of mobile devices. The main aim of this project is to develop an Android service that can support and run the game theory functions. My part in this project focused on developing a database on Android Studio, which can be run on Android devices. This database can hold the basic user details, such as name, email, and student ID. I had to understand the working of Wi-Fi peer-to-peer and how it supports instant data transfer, which is much faster than that through Bluetooth. The purpose of this project was to help build applications enabling data sharing among users and aiding gameplay for multiplayer games.

Advisor: HUI Pan / CSE
Student: YU Zheqing / COMP UROP Course: UROP1100, Spring 2016

Nowadays, with the growing use of digital devices, devices, such as computers and cellphones, have become of chief importance. Although forensic science studies the scientific method of gathering and examining information regarding the past, a new area called cyber forensics ensures cyber security and information assurance. Here, we mainly focused on one medium, WhatsApp, a mobile messaging application with over 800 million users, to obtain forensic artifacts. This report contains four parts: a technical overview, related works, system implementation, and future work.

Advisor: HUI Pan / CSE
Student: GAO Shenlai / COMP UROP Course: UROP1100, Spring 2016
UROP2100, Summer 2016

We previously designed and implemented a face detection application, which supports local face detection and offloading face detection of image files and plans to extend and optimize its functionalities. The current application uses the SQLite database to store the required data for optimization of face detection and recognition. The well-known computer-vision library OpenCV was used to develop an API for face recognition. Currently, the face recognition function is in the process of implementation. The result of testing has shown some improvement in face detection functionalities. Compared with first-time face detection, significant decreases in time have been noted following face detection. For example, for five-face image files, time taken for second-time face detection is a maximum 65% of that for first-time face detection, whereas for one-face image files, which have a relatively small size, the difference is only 5%. For most images with a size of approximately 7 MB, time taken for second-time face detection is 25%–35% that for first-time face detection. These data reflect a significant decrease in the required computing time and power by using the SQLite database.

Advisor: HUI Pan / CSE
Student: LI Bo / SENG UROP Course: UROP1100, Summer 2016

This project aims to introduce the basic concepts of algorithmic game theory. The project aims to develop an app, which enables two Android devices to build a Wi-Fi Direct connection, on the basis of P2P technology, a JAVA development environment, and an Android platform. Under the connection provided by the application, two devices form a group. The group owner device is considered the server and the other device is considered the client. The connection provides the function of file transmission and communication, such that two devices can share the same resource and operation. Compared with Bluetooth, Wi-Fi P2P projects have the advantages of faster and more efficient transmission and longer connection distance.

Advisor: HUI Pan / CSE
Student: XU Jiarui / SENG UROP Course: UROP1100, Summer 2016

The main objective of this project is to implement a Wi-Fi peer-to-peer (P2P) communication application. The basis of this application is the Wi-Fi P2P protocol. The functions of the application are connection, chatting, and file transfer. The first step of the project involves setting up a Wi-Fi P2P connection by using a broadcast receiver and P2P Manager, which can initiate peer discovery, fetch peer lists, and connect to peers. The second and third steps of the project are to implement two-directional chatting and file-transferring function with a standard Java Socket. With Inputstream and Ouputstream of Socket class, devices can set up channels for sending data to and receiving data from each other.

Keywords—Wi-Fi Peer-to-Peer, Socket, connection, chatting, file transferring.

Augmented Reality on Wearable Devices

Advisor: HUI Pan / CSE
Student: NAMKUNG Hee / CPEG UROP Course: UROP1100, Spring 2016

ARToolKit is an open source library for creating augmented reality apps on smartphones, wearables, or any other device running Android or iOS. Artoolkit can use natural feature tracking to detect or track an image and display a 3D object on top of it. However, the current library has limitations in displaying multiple objects. It only allows the display of one object at a time, thus increasing the constraint on its potential of augmented reality applications. In this paper, we modify the source code to detect or track multiple images and display multiple objects on them. In addition, we observe this affects the performance of the augmented reality app because of heavy system resource usage.

Advisor: HUI Pan / CSE
Student: SHIN Wai Ching Martin / CPEG UROP Course: UROP1100, Spring 2016
UROP2100, Summer 2016

Augmented reality (AR) projects virtual data into the physical real world, expanding people's perception and interaction from the digital space to the physical world. With advanced computer vision techniques, available online data, and multiple sensors, more creative and interesting AR applications can be developed. Our project focuses on the application of machine learning techniques, particularly convolutional neural network, to enable computers in recognizing and tracing the movement of fingers through input from the camera. This tracking of gestures can provide a user with a more immersive AR experience through the precise and intuitive interaction with virtual objects in an AR environment.

Machine Learning on Wearable Devices

Advisor: HUI Pan / CSE
Student: ARSHAD Mohammad Arslan / COMP UROP Course: UROP2100, Fall 2015

The popularity of mobile and wearable devices has increased rapidly in recent years, thus becoming a catalyst for shifting PC applications to the mobile platform. According to an announcement made by Google on May 10, 2011, the official Android Market has reached a milestone of 200,000 apps. Compared with nonmobile hosts, mobile devices possess several advantages, such as flexibility. In the field of face recognition, it is simpler and more convenient for a smartphone to capture images and provide prompt feedback, this flexibility has become vital. However, the limitation of computational resources on mobile device impedes sophisticated tasks, such as machine learning. This report describes an overview of the implementation of a simple face and fist recognition project on Android devices.

Advisor: HUI Pan / CSE
Student: LIU Xin / CPEG UROP Course: UROP2100, Fall 2015

The ownership of mobile devices with video-recording functionality has been ubiquitous; a new industry of wearable technology, many products of which incorporate video cameras, is rapidly developing. For instance, Google Glass has drawn much attention from the general public. However, the increased use of these devices with video-recording functionality, particularly wearable devices that can unobtrusively perform visual information collection (i.e., video recording and photography), may increase the risk of personal information disclosure. Although holding an intuition, such as when a majority of people object to secret videotaping with these devices and fret over the associated possibility of privacy intrusion, is sensible, so these intuitions require robust vindication. This paper will present the results of an empirical survey on people's attitudes toward unnoticeable videotaping, and propose a feasible resolution to ensure the future prosperity of wearable technology industry.

Advisor: HUI Pan / CSE
Student: QI Haozhi / COSC UROP Course: UROP1100, Fall 2015
Student: YU Zheqing / COMP UROP Course: UROP1100, Fall 2015
Student: ZHANG Jingyang / COMP UROP Course: UROP1100, Fall 2015

Nowadays, with the growing awareness regarding privacy leaks, an increasing number of people do not want to be photographed by others during social occasions (e.g., cocktail parties). Therefore, this UROP project aims to study privacy disclosure by using object and face detection to protect those who do not want to be photographed and blur their image before saving to local devices. We have basically created three detecting schemes: through tag detection (Section 4.1), face detection (Section 4.2), and hand gestures (Section 4.3).

Advisor: HUI Pan / CSE
Student: WANG Ziyu / ELEC UROP Course: UROP1100, Spring 2016

This project aims to embed the face recognition algorithm, which achieves a favorable balance between the execution speed of the program and the accuracy of face detection. The main task is to process the face image before feature extraction. Some experiments are then conducted on all reasonable LBP methods to calculate the result of the similarity of new faces and stored faces to predict and identity that person. Subsequently, a method will be decided to obtain minimum errors in face detection. Finally, the speed of executing is improved by applying native C++ codes to the Android project. This report explains the aforementioned procedures exhaustively.

Advisor: HUI Pan / CSE
Student: CHEN Minjian / MATH-CS UROP Course: UROP1100, Summer 2016
Student: HUANG Xuhua / SENG UROP Course: UROP1100, Summer 2016
Student: ZHU Ge / COMP UROP Course: UROP1100, Summer 2016

Affective computing has several applications and great potential. This project aims to develop an emotion-sensing system from hardware to software. With regard to hardware, the system is developed using an Arduino board and USB camera; the device is more portable and unobtrusive because only the USB camera is exposed while other components remain hidden. This project also aims to improve the previous algorithm of the system to enhance the performance of emotion recognition. Thus, the project is divided into three parts: Arduino board development, USB camera implementation, and algorithm improvement.

Privacy by Design Meets Mobile Computing

Advisor: HUI Pan / CSE
Student: LINGYS Justinas / CPEG UROP Course: UROP1100, Spring 2016

Nowadays, mobile phones are significant in people's lives and are involved in many social actions, such as recording life events and just photographing a snapshot of an attractive object. However, such actions can often breach rights to privacy of passersby by potentially recording some of their private information accidentally while photographing.

Considering the preceding concerns, I worked on this Undergraduate Research Opportunity Project (UROP) that involved modifying the Android operating system such that the camera(s) of a mobile phone would enable its user to distort unwanted objects so that the issue of privacy breach is resolved. In this report, I present my UROP results and propose a future path for the project to achieve a working prototype.

Internet of Things (IoT) with Ardunio

Advisor: LI Xin / CSE
Student: REN Da Wei David / PHYS-IRE — UROP Course: UROP1100, Spring 2016
Student: YAN Nuoyuan / COMP — UROP Course: UROP1100, Spring 2016

Arduino is an open-source microcontroller board that can be used to construct digital devices and interactive objects that can control physical devices and sense their environment. These devices are crucial to the growing "Internet of Things" industry for data collection and decision actualization. In this project, we use Arduino to centralize data collection for parameters, such as air temperature and soil humidity, by using different sensors. We aim to help people optimize gardening by determining the exact environmental conditions of the plants. We have set up our model of Arduino circuits and specified what data we plan to collect. Future developments include data management, actualization, and prototype construction.

What Makes a Good Programming Course for Youngsters

Advisor: LI Xin / CSE
Student: LIU Heshan / SENG — UROP Course: UROP1000, Summer 2016
Student: ZHOU Yingqi / COSC — UROP Course: UROP1000, Summer 2016

The ability to code computer programs is a critical part of literacy in today's society. Coding allows you to use the computer as a tool to express yourself and realize your creative ideas.

Teaching the youth coding is extremely popular nowadays. An experienced programmer might develop a good code with his or her expertise. Programming can also be considered the art of creating effective and beautiful instructions for the computer. We investigate an effective method to teach programming, particularly to the youth. This project aims to develop a programming course for secondary students, who do not have previous programming experience. We will assess the learning outcome of the students and summarize key points affecting their learning.

Recognizing Handwriting Digits

Advisor: LIN Fangzhen / CSE
Student: LIN Geng / COMP — UROP Course: UROP3100, Fall 2015

The input data to a perceptron, which are images of handwritten digits, are converted to either {0,1} or {−1,0,1}. After testing both approaches, the second is favored. An appropriate learning rate and range of initial random values are also noted. Two algorithms for training a group of perceptrons are investigated. One fails to produce a group in an acceptable time, whereas the other provides a group that is perfect for the training data if the input is converted to {−1,0,1}. However, it does not perform well when tested with a testing data set. Future research regarding the cause and possible improvement is possible.

Making Sense of Images on Twitter via Contextual Text

Advisor: NG Wilfred Siu Hung / CSE
Student: BAI Chunyan / COSC — UROP Course: UROP1000, Summer 2016
Student: TAM Kiu Fai / RMBI — UROP Course: UROP1000, Summer 2016

Text data are of vital importance in NLP and big data applications nowadays. Modern search engines, such as Google, provide powerful image search by analyzing numerous text data on webpages; however, this method is time-consuming. As an increasingly popular social medium, Twitter can provide data regarding the latest events, much faster than traditional image search. In this paper, we propose a new methodology to query images with texts on Twitter. This method combines the existing text processing methods with our original ideas. Our experiments on large Twitter data have demonstrated the reliability and efficiency of the new method.

IEEE VAST Challenge

Advisor: QU Huamin / CSE
Student: CHEN Yuan / COMP — UROP Course: UROP1100, Summer 2016
Student: FENG Haoan / ELEC — UROP Course: UROP1000, Summer 2016

With an intrinsic tendency of expansion, companies employ more people; the resulting problems in employee organization, resource distribution, and anomaly detection have gained increasing attention from managers, governments, and data scientists. In addition, intelligent building systems are currently being explored by many renowned companies, thus producing established products that have been in service for years. However, the degree of intelligence of these systems still requires improvement, and in this process, understanding and analyzing large amounts of data becomes highly essential. The visualization of the real-world sensed data is one of the most effective approaches to reduce the complexity of these problems. After being expressed in the form of charts, sounds, and even interactive controllable panels, an interesting pattern and remarkable anomalies may be revealed easily. We will introduce our system GAStechVis, a visualization tool that helps in analyzing data to identify potentially interesting patterns in the data.

Pulse of HKUST

Advisor: QU Huamin / CSE
Student: DU Xinnan / COSC — UROP Course: UROP1100, Summer 2016
Student: YU Zheqing / COMP — UROP Course: UROP1000, Summer 2016
Student: WANG Ziyu / CPEG — UROP Course: UROP1000, Summer 2016

In this report, I introduce a visual analytic system, GAStechVis, developed by our team for the minichallenge 2 of the the IEEE VAST Challenge 2016. In this challenge, a set of data containing staff's proximity card records and building data recorded by various sensors are provided. Our objective is to determine the typical pattern and anomalies appearing in the data. In this report, I focus on the system development and analysis of building data. We first clustered and divided the data into the following categories: power, temperature, airflow, and harmful gas. The system allows viewing the variation trend of each category, enabling or disabling different floors and energy zones, as well as selecting certain periods to obtain more details. To facilitate our analysis, we also developed a tool that enables customized visualization to achieve a deeper inspection of correlations between building and proximity card data. We will primarily focus on the analysis and findings using the system we developed.

Advisor: QU Huamin / CSE
Student: SRA Jai Singh / SENG — UROP Course: UROP1000, Summer 2016

Nowadays, the world is moving toward free data flow, providing people increased access. However, humans are not well equipped to manage large data sets in their raw form. Data visualization in more readily understandable

formats is essential. This report describes the progress of the Pulse of HKUST project aiming to make the HKUST campus better connected through increased and easy access and understanding of data.

Visual Analysis of Big Data

Advisor: QU Huamin / CSE Co-advisor: CHEN Lei / CSE
Student: CHEN Kejia / CPEG UROP Course: UROP1100, Fall 2015

This project uses data visualization provided by ACT, an examination system. The presented data are students' choices of a major in the first and second years as well as their interests and other relevant information. First, the data are processed, such that the relationship is clearly evident. Next, we focus on two points, year and subject of major, and then construct a diagram, finally revealing the relationship between students' majors and their actual interest.

Advisor: QU Huamin / CSE Co-advisor: CHEN Lei / CSE
Student: DUAN Yuqing / ELEC UROP Course: UROP1100, Fall 2015

Data visualization is the creation and study of the visual representation of data. It involves both computer science and art. In this UROP project, I gained the fundamental knowledge of data visualization methods and principles as well as the JavaScript and d3.js programming and realized my own data visualization design about the topic Global Internet Users by programming with d3.js. The data was from the World Bank Group website. Our aims are to show the direct and clear comparison and analysis results of the global Internet using circumstances in 2014 as well as the changes in Internet use circumstances over the past decade in 10 distinct representative countries.

Advisor: QU Huamin / CSE Co-advisor: CHEN Lei / CSE
Student: FAN Xinzhi / ELEC UROP Course: UROP1100, Fall 2015

Data visualization, which is the focus of this UROP, is a crucial and flourishing subject in computer science. This UROP visualizes the cooperation and funding of the school departments using d3.js to provide us an intuitive view of the research status of our university. This project report first provides background information on data visualization and d3.js, followed by data visualization of department cooperation and the funding of departments as well as the findings discovered from the visualization.

Advisor: QU Huamin / CSE Co-advisor: CHEN Lei / CSE
Student: HUANG Yu-ning / COMP UROP Course: UROP1100, Fall 2015

Air pollution has been a serious issue in most developed countries and their cities, including Hong Kong. As the problem worsens, scholars are emphasizing the potential risks of particulate matter in the air: particulate matter not only changes the weather and reduces visibility but also directly threatens human health. This project aims to analyze the distribution of fine suspended particulates (also known as PM 2.5 because of their size) in time and space dimensions to help in understanding the reasons underlying their distribution and propose the most appropriate strategies to counter the health risk problems.

Advisor: QU Huamin / CSE Co-advisor: CHEN Lei / CSE
Student: CHEN Taiyou / COMP UROP Course: UROP1100, Spring 2016
Student: YU Xinyuan / CPEG UROP Course: UROP1100, Spring 2016

WeChat, one of the newest and the most popular types of social networking app, currently plays a substantial role in information diffusion but leads to malicious information thriving across the Internet. This situation is becoming increasingly serious and needs to be controlled; thus, abundant research has been conducted on information diffusion on either content-based prediction or detection. Studies specifically focusing on the visualization of trends or patterns among different information types across the Internet are scant, necessitating

further research in this area. This paper describes the process used for finding valuable patterns characteristic of the diffusion process of different information types and for obtaining an effective solution for visualizing these patterns.

Keyword—information diffusion, pattern, visualization, microblogging.

Advisor: QU Huamin / CSE — Co-advisor: CHEN Lei / CSE
Student: CHEN Yuan / COMP — UROP Course: UROP1100, Spring 2016
Student: TIAN Xinran / COSC — UROP Course: UROP1100, Spring 2016

Big data contains a large amount of information; when studying big data, different methods are used to recognize useful messages. Here, we aim to analyze the characteristics of rumor dissemination on the WeChat platform through raw data in terms of message ID, user ID, parent message ID, parent user ID, publishing time, diffusion type, friend type, intimacy, city, as well as latitude and longitude of several rumors transmitting on this platform so that distinguishing and detecting rumors in the large of information becomes easier and more accurate. In this research, we selected a data visualization method to summarize and present messages concluded from data, for displaying the results dynamically and interactively. Time and geographical information were visualized as major characteristics of one single rumor, along with other information presented when required. Thus, with the change of time, the change in performance of different rumors can be observed on WeChat, indicating their regularity in terms of time. Moreover, through the geographical information encoded in the visualization platform, the relationship between rumor dissemination and its travel paths can be analyzed clearly and specifically. Therefore, tracing the time and geographical information of rumors can aid in intuitive and informative display, thus providing a useful tool for future deep analysis on rumor transition.

Advisor: QU Huamin / CSE — Co-advisor: CHEN Lei / CSE
Student: WANG Binren / COMP — UROP Course: UROP1100, Spring 2016

Online social networking applications are one of the most efficient and widely used modes of communication. These applications can minimize the restrictions of distance and form of communication, thus providing significantly convenient and accelerated transition of information worldwide. Simultaneously, serious problems, such as transmission of rumors, have occurred because of the increased speed and distance information transmission.

Rumors, wrong but convincing information, can easily spread and arouse panic or anger among the unsuspecting general public. Although multiple users may be involved in the process of information diffusion, some key nodes are required to control the transmission of rumors. Because of the profound problems caused by them, the detection of influential nodes is a research focus for developing more efficient online social networking applications. In this report, the study of the diffusion pattern of rumors on the WeChat “Friend Circle” platform is described and the distribution of influential nodes on the basis of this diffusion pattern is discussed.

Advisor: QU Huamin / CSE — Co-advisor: CHEN Lei / CSE
Student: ZHAO Lucen / COMP — UROP Course: UROP1100, Spring 2016

In the development of online social networking platforms, the spread of rumors appears to be a major concern. In this report, the study of algorithms for determining influential nodes in spreading rumor on the WeChat “Friend Circle” platform is described. Conventional algorithms have defects, such as ignoring nodes present in different communities and high costs for large graphs; thus, a derived algorithm called the community-based greedy algorithm was selected as the appropriate method to determine influential nodes on this platform.

Advisor: QU Huamin / CSE
Student: LI Haotian / SENG — UROP Course: UROP1000, Summer 2016
Student: YIN Hang / SENG — UROP Course: UROP1100, Summer 2016

The mass transit railway system (MTR), a rapid transit railway system in Hong Kong, is gradually developing at an increasing speed. Thus far, it already has more than 10 routes and has expanded its business through building shopping malls in stations and through property management. As a crucial part of Hong Kong's economic growth, the related statistics are of great significance. However, the tables with numbers can be somewhat difficult to interpret. Alternatively, by visually analyzing the collected data from vast resources, we may understand the actual progress of the development more straightforwardly; this is the aim of our research.

Advisor: QU Huamin / CSE
Student: SIM Kyu Doun / SENG UROP Course: UROP1000, Summer 2016

For the Pulse of HKUST project, our team focused on gathering data from the articles of schools of engineering webpages to identify any patterns or interesting characteristics of different departments. By using a specific Python library (BeautifulSoup4 and Scrapy) and a HTML and Javascript library (D3), our team constructed data and visualized them. The static system and dynamic system provided remarkable insights, such as the diversity of articles among different departments and the dominant types of articles in each department. Furthermore, the comparison between the Computer Science Department and the Electronic and Computer Engineering Department provided interesting information for analysis.

Visual Analysis of Financial News Articles

Advisor: QU Huamin / CSE
Student: CHE Sen Hei / COGBM UROP Course: UROP1100, Fall 2015

By using the Internet of Things and free access to the Internet, data collection has become much easier than before. Compared to data collection, data analysis is more crucial; data visualization can help researchers to further understand the data and analyze them more accurately. This report includes the process of learning data visualization science—from the concept to the method of data visualization to analyze data and several data visualization results. The report also provides and discusses the channel that can obtain access to the data and results of data visualization analyses.

Advisor: QU Huamin / CSE
Student: DENG Bowen / CPEG UROP Course: UROP2100, Fall 2015

Deciding on a university major is always a major concern for a student. Some students may select their majors by considering their interests first. By contrast, some students may have different priorities, influenced by many factors. In general, these factors can determine students' grades and even their future career. Therefore, determining the relationship among these factors, such as students' interests and choice of major, is necessary. Here, this relationship was efficiently determined using ACT, a world-class examination system, which generated a sample data set; this data set was then used by manipulating the data visualization tool to elaborate on the rules underlying students' choice of major.

Visualization Techniques for 3D Urban Environments

Advisor: QU Huamin / CSE
Student: CHOI Hong Joon / COMP UROP Course: UROP1100, Fall 2015
Student: NG Chung Ki / ELEC UROP Course: UROP1100, Fall 2015

In public and academic domains, the demand for analyzing the performance of a university and comparing it with that of other universities is high. Several university rankings websites exist, with each ranking universities according to varied set of rules. To better understand the performance of a university by using these ranking data, it is crucial to compare as much data as possible; in addition, within a ranking system, different aspects of the university scores should be compared. However, comparing data from various websites can be difficult for an individual. Here, we use two visualization techniques to enable users to more easily compare and evaluate the

data provided on the ranking sites. In this paper, we focused on one of the three prestigious ranking sites: QS, THE, and ARWU.

Advisor: QU Huamin / CSE
Student: ZOU Yuxuan / CPEG UROP Course: UROP2100, Fall 2015

This article introduces a web system that visualizes the kinship features of the Liaoning Province in China during 1749–1909 in the Qing Dynasty period, mainly by visualizing the genealogies of the families by using family trees with population flow over time and highlighting family features. This is the first visualization system posted on Inter-university Consortium for Political and Social Research. The system is a joint work of two students under Professor Huamin Qu's supervision—Siwei Fu, a PhD student, and Yuxuan Zou, an undergraduate student. The online system is available at http://kinship_lee_campbell.meteor.com.

Advisor: QU Huamin / CSE
Student: WU Aoyu / CPEG UROP Course: UROP1100, Spring 2016

MOOCs have become increasingly popular in educational institutions. However, problems regarding their effectiveness remain unresolved. Unlike the traditional teaching mode, course instructors cannot obtain real-time feedback from students through face-to-face communication. To tackle this problem, we perform visual analysis on the correlation between course video semanteme and user feedback under MOOCs. The user feedback can be described by a user click stream. In terms of course video semanteme, information, such as lecture notes, digital speech, and face activity, can be extracted. Visualization techniques provide an interface to view the correlation between the feedback and semanteme. This report focuses on the details of information extraction.

Automatic Photo Capturing Using Drones

Advisor: QUAN Long / CSE
Student: ZHOU Wenxuan / COMP UROP Course: UROP1100, Spring 2016

The reactor pattern is a design pattern for handling requests delivered to the server concurrently. The event handler then demultiplexes the requests to their associated handlers. This design pattern simplifies the structure of the program such that the program can be divided into modular parts and can be modified easily. The reactor is composed of four parts: resources, synchronous event demultiplexer, dispatcher, and request handler. There have been many mature libraries for this task, such as libevent. These libraries can work on different platform, making them extremely complex and difficult to use. Thus, I developed a simple library, which can be used in small websites, it only focuses on Linux and can fulfill most requirements of development.

Advisor: QUAN Long / CSE
Student: LI Yefeng / CPEG UROP Course: UROP1000, Summer 2016

Professor Quan is leading a team working on UAV automatic capturing and large-scale 3D reconstruction. For reconstructing 3D models from 2D images, the knowledge of computer vision and computer graphics is required. Software is needed to apply these 3D models for various purposes. During my study period, I worked with this team and investigated and practiced two tasks: (1) parsing the resources from the 3D reconstruction, an orthomaps bitmap with embedded geographic information, and (2) visualizing them on map-viewing tools on a webpage in web browsers and in applications on the Android platform, by creating overlays onto base maps.

Efficient Queries over Database

Advisor: WONG Raymond Chi Wing / CSE
Student: WAN Jia / COMP UROP Course: UROP2100, Fall 2015

A k-regret query is an operator to support multicriteria decision-making without the input of utility functions. In particular, we minimized the maximum regret ratio. In a previous paper "Regret-Minimizing Representative Databases," the author proposed the algorithm "CUBE" forming an upper bound and proposed a lower bound for the maximum regret ratio in a 2-dimensional case. This report mainly extends the lower bound to d-dimensional case to potentially form a tight bound for another algorithm by using angle division with an upper bound of the same complexity.

Advisor: WONG Raymond Chi Wing / CSE
Student: ZEIGHAMI Sepanta / COMP UROP Course: UROP2100, Fall 2015
UROP3100, Spring 2016

We propose the average regret ratio as a metric to measure users' satisfaction after a user sees k selected points of a database, rather than all points in the database. We introduce the average regret ratio as another method of multicriteria decision-making. Unlike the original k-regret operator that uses the maximum regret ratio, the average regret ratio considers the satisfaction of a general user. While assuming the existence of some utility functions for the users, in contrast to the top-k query, average regret ratio does not require a user to input his or her utility function but depends on the probability distribution of the utility functions. We prove that the average regret ratio is a supermodular function and provide a polynomial-time approximation algorithm to determine the average regret ratio minimizing set for a database. In this report, we show how our algorithms and methods of calculating average regret ratio work in practice. Here, we discuss in detail our empirical studies and the experimental evaluation of our algorithm in comparison with other existing methodologies.

Advisor: WONG Raymond Chi Wing / CSE
Student: LUENAM Phoomraphee / SENG UROP Course: UROP1000, Summer 2016

k-Regret minimizing sets is a technique enables the selection of a small set of points to represent a data set while ensuring that the output of any possible utility function used on the representative set remains adequately high. We show that no polynomial time approximation algorithm with a finite approximation factor exists for the general case of this problem. We also explore the version of this problem while only considering a subset of possible utility functions. Finally, we define an equivalent k-happiness–maximizing sets problem, which is inapproximable in the general case as well as has simpler performance bounds, which leads to a polynomial time approximation algorithm when d, the number of dimensions, is fixed.

Knowledge Discovery over Database

Advisor: WONG Raymond Chi Wing / CSE
Student: CHEN Liyu / COSC UROP Course: UROP3100, Fall 2015

Data mining has recently become a topic of great interest because of the surplus availability of relevant ongoing information. Many fancy applications have been invented on the basis of data mining techniques and big data. For instance, by using a large high-quality training set, a program can be trained to complete some manual tasks with performance similar to a real human. However, a good training data set is often difficult or even impossible to obtain because of numerous constraints; for instance, the data set may not be sufficiently large or contain too much noise, leading to poor performance of the program. In the last semester, we developed an e-mail classification program; however, it provided poor results because of the small and noisy keyword set extracted from the e-mail segment data set of the Radica Company. In the next steps of the project, we will mainly focus on extending the previously obtained keyword set for improving the performance of our e-mail classification program in this semester. Our major method of extending the keywords set will be to collect relevant results from Google search engine and extract keywords from these results that are highly representative of a certain topic and would appear in the e-mail title.

The remaining report is organized as follows: We first briefly introduce how we extracted data from Google and extracted keywords from the retrieved data. We then describe several difficulties we encountered in applying this

method and the corresponding solutions we used to resolve them. We conclude the report by presenting the classification results by using the extended keywords set and then describe our future work in this project.

Advisor: WONG Raymond Chi Wing / CSE
Student: WANG Tianci / COMP UROP Course: UROP3100, Spring 2016
Student: ZHANG Xiang / MATH-CS UROP Course: UROP3100, Spring 2016

In this semester, we explored several aspects of knowledge discovery over databases, mainly by reading papers and reviewing others' work. We examined areas including a spatial database, graph database, and social networking. After reviewing, we mainly deliberated on ideas to improve the problem statement and methods for these two problems. In the rest of this report, Zhang Xiang demonstrates his remarks and thoughts on how to improve the algorithms for robust influence maximization, while Wang Tianci presents his reviews and ideas on the paper "Finding Shortest Paths Considering the Requirements of Users."

Advisor: WONG Raymond Chi Wing / CSE
Student: ZHOU Wenxuan / COMP UROP Course: UROP1100, Summer 2016

Determining dependencies between concepts in an open course is of great importance, and this can be used to aid students in arranging their study plan. In my project, I divided the dependencies into two categories: direct and connotative dependencies. Both have different properties and can be observed using different techniques. Direct dependencies can be demonstrated using relation extraction, before which a dictionary should be built, followed by performing anaphora resolution over the text. Connotative dependencies can be determined by attaching themes to the text. Many open courses are available on the Internet. In this project, we consider the course "Regression" on Coursera as an example; the course has four levels of directories, just as illustrated in the following figure:

Research on Mining Course Structure

Advisor: WONG Raymond Chi Wing / CSE
Student: CHEUNG Tsz Him / COGBM UROP Course: UROP1100, Summer 2016

College courses are generally offered with prerequisites to ensure that students master certain basic knowledge before learning more difficult courses. We believe that this is also true for learning concepts within a single course. In this project, we demonstrated such an idea by using a scoring system in a web environment, enabling a user to input students' performances and providing them with several suggested study pathways. This project mainly focuses on the construction of the dependency and its application in study pathway recommendations. Some possible methodologies of information extraction and knowledge graph construction are also discussed in the first part of the report.

Machine Learning Algorithms for Predicting Student Performance in Massive Open Online Courses

Advisor: YEUNG Dit Yan / CSE
Student: ZHAO Zixuan / COSC UROP Course: UROP1100, Summer 2016

This report describes and compares some basic machine learning models and algorithms used to assess and predict the learning performance of students in MOOCs. Three experiments were performed on the basis of students' performance data on Science of Gastronomy course. The first and second experiments classified students' final performances into three categories by using their weekly activities; however, the second experiment also included data overlapping and accumulated data variably from weekly. The final experiment resolved a regression problem on the basis of raw final scores and then categorized and compared this with classification results. The experiments revealed that ensemble methods, such as a gradient boosting tree, are the most suitable for resolving the problem.

Security Analysis for HTML5+Javascript Applications

Advisor: ZHANG Charles Chuan / CSE
Student: WONG Ming Kit / COGBM UROP Course: UROP1100, Fall 2015

Accessing web services has become a part of daily life for most people nowadays. People rely on the Internet to perform several operations, such as web surfing, e-mail, social networking, and shopping. Web applications using HTML5 and JavaScript are hosted to provide such services to users. However, the wide adoption of HTML5 and JavaScript in building web applications potentially exposes users to security threats. Vulnerable web applications may leak users' personal information to unauthorized people. This paper reports studies on several common web applications security flaws, namely SQL injection, cross-site scripting (XSS), and cross-site request forgery (CSRF), in some open-source web applications.

Advisor: ZHANG Charles Chuan / CSE
Student: CHANG Hsin-wen / SENG UROP Course: UROP1100, Summer 2016

Both SourceBrella Pinpoint and Facebook Infer are static analysis tools that can identify critical bugs. This project focuses on comparing the bug detection performance of both Pinpoint and Infer by feeding both programs with C codes, followed by provide feedback and suggestions targeting the user interface of Pinpoint and Infer. In addition, UE design is created using self-learning web design-related knowledge for deeper understanding of the topic.

Detecting Topics in Web Documents Returned by Google Search

Advisor: ZHANG Nevin Lianwen / CSE
Student: XIA Jiacheng / COSC UROP Course: UROP1100, Spring 2016

Search engines can sort results on the basis of the relevance and click-rate of the webpages with keywords, but they cannot divide the results into the suitable groups. On the other hand, hierarchical latent tree models (HLTMs) are effective for performing similar tasks on large data sets of journal articles; this paper discusses an experiment for dividing webpage results by using an HLTM. Some results regarding the recent topics of interest are also presented, along with the shortcomings and effectiveness of the experiment.

Department of Electronic & Computer Engineering

Nano-Transistor Modeling for Circuit Simulation

Advisor: CHAN Man Sun / ECE
Co-advisor: ZHANG Lining / ECE
Student: LIU Kuan-fu / ELEC
UROP Course: UROP1100, Fall 2015
Student: ZHANG Yuanzhao / ELEC
UROP Course: UROP1100, Fall 2015

Integrated circuits are a crucial part of electronic appliances; to improve the circuit performance, further understanding the behavior of transistors is necessary. In this project, we used HSPICE to simulate the current and voltage behavior of different existing PMOS and NMOS models. In particular, we used an oscillator to demonstrate the aging effects of transistors caused by the threshold change in the long term. In this report, we have divided our simulations into three parts: first, the phenomenon of circuit aging is demonstrated; then, the reason for such a change, which is the threshold change of transistors, is analyzed, followed by the extraction of a single PMOS transistor and running a simulation on it to justify our conclusions through current behavior.

Advisor: CHAN Man Sun / ECE
Co-advisor: ZHANG Lining / ECE
Student: BEN AYED Ahmed / ELEC
UROP Course: UROP1100, Spring 2016
Student: MEHTA Jainam Bharatkumar / ELEC
UROP Course: UROP1100, Spring 2016

This project report outlines our work and research performed over 4 months on the topic “Nano Transistor Modelling for Circuit Simulation.” Integrated circuits are an essential part of gadgets used in our daily lives, and the improvement of these products relies on the improvement of transistor technology. Considering the scope of transistors on a nanometer scale, this report examines graphene field effect transistor (GFET) operation in detail. The report discusses the three device operation regions for a GFET and then explains a simple MATLAB model to examine the device characteristics in each of these regions. Finally, the obtained simulations and results are presented and crucial parameters and design equations mentioned.

Semiconductor Nanowire-based Sensors and Electronics

Advisor: FAN Zhiyong / ECE
Student: WU Yue / CPEG
UROP Course: UROP2100, Fall 2015
UROP3100, Spring 2016

The fall semester report detailed on our experimental process, the control variate method for finding the most favorable conditions for target shapes of membranes, the barrier thinning process, as well as the development of inverted triangular side section. Based on the achievement in past two semesters, this report focuses on three elemental process of fabrication demanding anodic aluminum oxide (AAO) membranes. First, the background section mentions some examples regarding programmable engineering methods for manufacturing these nanostructures. Second, hard and mild anodization is explained and compared, followed by a discussion of freestanding AAO. Finally, this study describes the invention of the inverted-nanocone (i-cone) AAO structure.

3D Display

Advisor: KWOK Hoi Sing / ECE
Student: OU Yanghui / ELEC
UROP Course: UROP1100, Fall 2015

This article first introduces the basic 3D imaging principle and explains the reasons that a typical three-dimensional (3D) display on an electronic screen makes an audience uncomfortable. Some novel stereoscopic and autostereoscopic 3D techniques are then discussed.

Stereoscopic 3D techniques focus on wavelength multiplexing visualization and the shutter glasses technique, whereas autostereoscopic 3D techniques introduce parallax barrier and light field display. Finally, software applications for constructing a 3D display is discussed.

Electricity Generation by Compressed Air

Advisor: KWOK Hoi Sing / ECE
Student: OU Yanghui / ELEC — UROP Course: UROP1100, Spring 2016
Student: YAU Hon Man / ELEC — UROP Course: UROP1100, Spring 2016

The demand for a renewable energy sources is increasing nowadays because of the extensive use of electricity and transportation fuels. To resolve this situation, various approaches using compressed air energy storage (CAES) as one of the most competitive technologies, has been developed. This paper introduces CAES. Because the use of collected compressed air is essential, the design of a conventional turbine is also described, followed by our unorthodox log-spiral flywheel. Finally, the limitations of and potential improvements in our design are mentioned.

Object Detection and Recognition for Underwater Computer Vision

Advisor: LI Zexiang / ECE — Co-advisor: WIDY Andreas / ECE
Student: CHEN Yau Pun / SENG — UROP Course: UROP1000, Summer 2016
Student: UY Mikaela Angelina Chan / COSC — UROP Course: UROP1000, Summer 2016
Student: YOON Hongseo / SENG — UROP Course: UROP1000, Summer 2016

The aim of this project is to detect a specific object-class underwater diver for developing an automated underwater vehicle (AUV): the main objective is detecting the presence of the underwater diver on a live video frame and then obtaining a bounding box surrounding the diver, which would then be passed to the tracking algorithm of the AUV. To simplify the problem, the researchers began with training, classifying, and recognizing static images. Various feature extraction methods and machine learning algorithms were used, and the researchers analyzed the performances and results of each. The researchers specifically used a Haar cascade, histogram of oriented gradients with support vector machines, and convolutional neural networks.

Pose Control of a Quadrotor

Advisor: LI Zexiang / ECE
Student: LIU Yuchen / ELEC — UROP Course: UROP2100, Spring 2016

Quadrotor has become increasingly popular for research as well as daily application in recent years as a new attractor in the global market. To control the pose of a quadrotor efficiently and accurately is the basis of higher-level design and secondary development. In the report of UROP1100, the fundamental physical model and the ground control were introduced in detail. Some modifications were also applied to the machine to understand a particular pattern of the route, such as hanging over automatically.

The next objective of UROP2100 for the same topic is analyzing the heart of the control system for commercial UAV, the robot operating system (ROS); understanding the function of this system as well as some upper application for it such as Rviz, a 3D visualization tool for ROS, is crucial. This report will discuss some basic knowledge on Linux system operation, ROS, as well as its upper application. It will focus more on the software end of programming control rather than a theoretical equation or physical model. During the project, the version of Linux system environment, Ubuntu 16.04, will be used, along with ROS-kinetic (the latest version).

Advisor: LI Zexiang / ECE
Student: ZHANG Zizheng / ELEC — UROP Course: UROP1100, Spring 2016
UROP2100, Summer 2016

The aim of this project is to conduct studies to optimize the pose control of a quadrotor. To study the control process in detail and make it convenient for researchers to monitor the product before manufacturing the first prototype, a visualization UI is required. This UI must contain basic posture- and movement-monitoring methods and should be user-friendly; that is, the users must be able to customize the UI to fit their own needs. Importing the industrial robots or quadrotors' model into the UI is crucial—this is main point of this report. During this project, we are mainly using Linux OS, a robot operating system, and Rviz.

Keywords—pose control, UI, model, robot operating system.

Vision-based Formation Flight of Micro Aerial Vehicles

Advisor: SHEN Shaojie / ECE
Student: LI Zimo / CPEG UROP Course: UROP2100, Fall 2015

The objective of this UROP is to build a monocular visual odometry system with inertial sensors on the basis of a ROS. In the summer term, I mainly focused on the first half of the multistate constraint Kalman filter—the processing of the features flow and inertial measurement units data and that of triangulation. In this semester, I am working on the covariance computation and update step, such as residual computation and Kalman gain computation. Similar to previous works, all data are based on a simulated environment rather than the complicated real world.

Advisor: SHEN Shaojie / ECE
Student: CHEN Shixi / ELEC UROP Course: UROP1100, Summer 2016
Student: LIU Qinhan / SENG UROP Course: UROP1100, Summer 2016
Student: SHI Yifei / ELEC UROP Course: UROP1100, Summer 2016

This report demonstrates some tasks accomplished during the summer of 2016. We first assembled four microaerial vehicles and added several modules, such as Bluetooth and flight controller, to each of them. The flight controllers were then initialized and tuned up with remote controllers using QGroundControl. Finally, the four vehicles were checked for proper functioning; then, we were assigned to design a user interface, with which we could send commands such as those of takeoff, landing, and hovering, by clicking a single button. The UI was designed on Qt and realized on ROS. All detailed information is described in separate hardware and software sections. In section 5, we summarize the entire process of the project.

PID Control for Airship

Advisor: SONG Shenghui / ECE
Student: WONG Cheuk Fung Raphael / ELEC UROP Course: UROP1100, Spring 2016

The ENGG1200 airship design course requires students to construct and control an airship to complete certain tasks. The airship is controlled by an open-loop system, which makes stabilization difficult. In this paper, we explore the implementation of a closed-loop feedback system with proportional–integral–derivative (PID) control for autostabilization. By systematically determining the PID coefficients, the airship can stabilize and return to its original position in the yaw rotational axis.

Advisor: SONG Shenghui / ECE
Student: CAI Fengyu / ELEC UROP Course: UROP1000, Summer 2016
Student: LEE Wing Hang / CPEG UROP Course: UROP1000, Summer 2016
Student: LIAO Kunjian / ELEC UROP Course: UROP1100, Summer 2016
Student: YAO Xinjie / SENG UROP Course: UROP1000, Summer 2016

The course ENGG 1200 requires students to design and construct the airship to follow certain instructions. However, because of its open-loop system, the airship is extremely difficult to keep stable. In our project, based

on the work done by CFR Wong and Z Dong, we developed a closed-loop feedback system with proportional–integral–derivative control for the autostabilization of airships. In this improvement based on the previous version, we stabilized the airship in all three dimensions (yaw, pitch, and roll), rather than only one yaw rotational axis.

Wireless Localization

Advisor: SONG Shenghui / ECE
Student: LAM Kin Chung / ELEC UROP Course: UROP1000, Summer 2016

This paper is separated in two parts. The first part explains the basic concept of indoor wireless localization systems (e.g., its importance and theory), whereas the second part details my part in this project and the conclusion. This localization system is based on the Wi-Fi system built in the campus and considers a large amount of data to improve its accuracy. The previous data-collecting method involves entering the location point directly and it is labor-intensive and time-consuming. My role is to make the localization system able to collect the location data more easily. With the graphic user interface, the user can select the location point by pointing at the map shown on the mobile device without entering the coordinates.

Aerial Smart-Phone Acrobat

Advisor: WONG Man / ECE Co-advisor: QIU Li / ECE
Student: FENG Haoan / ELEC UROP Course: UROP1100, Fall 2015
Student: SHAO Ruizhao / EEGBM UROP Course: UROP1100, Fall 2015

With the increasing popularity and rapid development of smartphones, the related software and hardware techniques have developed greatly, enabling increased performance and utilization. The main aim of this project is to design a quadcopter system by using the hardware of Android smartphones, namely CPU and several embedded sensors. The project is divided into several specific parts: dynamic system modeling, quadcopter parameter measurement, sensor fusion and control algorithm design, and Android application development (GUI and communication system). In this summary report, system modeling, quadcopter parameter measurement, sensor property, and control technique are described, along with our progress in the past semester. Further progress is required to achieve the remaining objectives and to alleviate the shortcomings of the presently achieved parts. The expected result is one quadcopter loaded with one smartphone controlling the movement of quadcopter and the other being controlled by the user.

Development of CMS for the "Auditory and Speech Training App"

Advisor: WOO Kam Tim / ECE
Student: SUEN Heung Ping / COGBM UROP Course: UROP1100, Summer 2016

We developed a scalable, secure content management system (CMS) for managing the workflow of accessing, uploading, evaluating, and exporting voice samples collected from children for research purposes. Because the CMS cannot cater to all use cases of voice samples, we built the CMS on the basis of a set of RESTful APIs that third parties, such as research units, can use to extend the applications of the collected voice samples. To facilitate scalability of the system, all system components are designed to be stateless; that is, the server does not store information regarding individual requests, instead the components rely on individual requests to complete all transactions each time new requests come in.

Department of Industrial Engineering & Logistics Management

Rapid 3D Insoles - Software

Advisor: GOONETILLEKE Ravindra Stephen / IELM
Student: QI Gengmo / CPGBM UROP Course: UROP1100, Spring 2016
UROP2100, Summer 2016

CAD software has long been used to design insoles and is available in different forms. However, very few customized CAD softwares are available for specialized applications, such as designing orthotic insoles. Therefore, rapid prototyping process of orthotic insoles is not user-friendly; various CAD softwares are frequently required to finish the design. Moreover, the challenge remains in how to completely parameterize insoles by using ergonomic parameters. Without parameterization, the design and 3D printing process can be extremely inefficient and time-consuming. After the insole CAD model can be fully parameterized, ordinary users can easily customize their insole, which specifically fits their foot shape.

Improving Precision in 3D Printing

Advisor: JONEJA Ajay / IELM
Student: ZHOU Yiyi / IELM UROP Course: UROP1100, Fall 2015

This project aimed at exploring the possibility to achieve higher accuracy in three-dimensional printing geometrically. If the shape of horizontal cross-sections with an area equal to the average slice area, rather than that of the cross-section of the original object at the height a layer will be deposited, is adopted as the shape of the layer, the resulting volume error is less and accuracy is higher. To determine the optimal cross-section in a slice, the layer volume is calculated and divided by the slice height to get the average area. Next, the cross-section having exactly the same area is searched for through binary search, and its shape is adopted as that of the layer. By using this method, volume error in 3D printing can be decreased.

Prediction of Game Sickness

Advisor: SO Richard Hau Yue / IELM
Student: GAO Xiaoyi / SENG UROP Course: UROP1100, Summer 2016

Nowadays, video games have become an increasingly crucial part of people's daily life. However, large groups of people are relatively afflicted by the sickness induced when playing games. This type of game sickness can be categorized into visually induced game sickness (VIMS); its symptoms include nausea, sweating, dizziness, and even vomiting. VIMS not only affects the experience of players but also causes a decrease in the sales of many games.

By analyzing different games and experiences with them, this exploratory study will examine the potential factors contributing to game sickness. Various factors may be involved, including one's own habits and frames per second in the game. The participants completed questionnaires, which indicated the extent of the sickness.

Department of Mechanical & Aerospace Engineering

Graphene Foam/Polymer Composites for EMI Shielding Applications

Advisor: KIM Jang Kyo / MAE Co-advisor: SUN Xinying / MAE
Student: ZHANG Yizhe / MECH UROP Course: UROP1100, Fall 2015

In this study, graphene/epoxy composite aerogels were fabricated using a unidirectional freeze-casting method for electromagnetic interference shielding application. The presence of reduced graphene oxide and the aligned structure in microscale could improve electric conductivity, resulting in high shielding effectiveness, and the epoxy matrix was involved in enhancing the mechanical properties of the composite. Graphene/epoxy composite aerogels with different graphene contents, 2–50 wt%, are fabricated. The SEM images show that the fabricated composites possessed a highly aligned porous structure.

Development of A Microfluidic System with feedback control for High-throughput Screening of Traditional Chinese Medicine

Advisor: LEE Yi-Kuen / MAE Co-advisor: TSIM Karl Wah Keung / LIFS
Student: CHEN Xia / CBME UROP Course: UROP1000, Summer 2016

Traditional Chinese medicine (TCM) has been taught for thousands of years in China and is considered a great treasure in pharmaceuticals, although modern research methods have not been employed widely to clearly demonstrate its efficacy. TCM for a certain medical purpose is typically a decoction of the mixture of different herbal drugs with specific mass ratios. However, to determine the optimizing formula, massive quantities of biological experiments resulting from possible herb combinations has become a major problem. In this project, skin whitening served as the ground, and feedback system control (FSC) was developed to conduct experiments efficiently for establishing a drug-input and efficacy-output programming system, such that the result of any drug combination could be predicted computationally and validated experimentally.

Development and Prototyping of a Smart Comfort Helmet

Advisor: LI Larry / MAE
Student: CHEUNG Yu Fu / MECH UROP Course: UROP1000, Summer 2016

Helmets insulate the head and prevent head injury; however, they increase sweat rate and local skin temperature. This thermal discomfort discourages helmet use. In the current market, most helmets are designed with active and passive ventilation to resolve this issue. In places with warm climates (e.g., Hong Kong), passive ventilation is not sufficiently effective and active ventilation requires the use of fans. However, fans are bulky and noisy and they generate fatigue and distract users. However, both the ventilation designs are not intelligent and cannot perform a feedback from internal temperature and humidity. Hence, the development of a helmet with thermal comfort, intelligent control, and safety is proposed.

Advisor: LI Larry / MAE
Student: HO Man Lee / SENG UROP Course: UROP1000, Summer 2016

A helmet is a crucial guard of the head during sports activities and industrial operations; wearing it is often uncomfortable because of insufficient or inefficient ventilation. The resulting thermal discomfort might cause discontinuation of helmet use and/or affect users' cognition systems, thus increasing the risk of accidents. The aim of this project is to enhance the thermal comfort through (i) a piezoelectric air mover synchronized in peristaltic motion to increase circulation between ambient air and the internal air, (ii) temperature and humidity sensors for monitoring and operating the air mover, (iii) Coanda nozzle to amplify the air flow, and (iv) desiccant honeycomb flow channels with embedded heater for controlling humidity. The team is currently constructing a

helmet with a rotating fan, which can stimulate an active airflow inside the helmet, and will then analyze the thermal effects of different airflow directions, after which the piezoelectric air mover will be studied.

Advisor: LI Larry / MAE Co-advisor: LAM David Chuen Chun / MAE
Student: YIU Tak Shing / MEGBM UROP Course: UROP1000, Summer 2016

The ultimate objective of this project is to develop a sensor-equipped helmet with heat-dissipating devices, which is more comfortable and effective in cooling than are existing heat dissipating helmets. To fulfill both requirements, a piezoelectric air mover with feedback sensors, which transports air through peristaltic motion, will be installed into bike helmets in a nonintrusive manner. However, before developing this prototype, the cooling effect of an existing bike helmet must be investigated specifically to quantify the minimum cooling effect, which the prototype has to achieve in a specific helmet. Moreover, the existing designs of peristaltic air movers must be investigated to develop new designs, which can be accommodated in the small volume of the helmet when it is worn and have high cooling effect, leading to a high rate of simultaneous air movement. In this report, the procedures by which the cooling effects are investigated is described, along with a review of the existing designs of miniature bendable peristaltic air movers.

Development of an Unmanned Aerial Vehicle (UAV) for Agricultural Spraying and Monitoring

Advisor: LI Larry / MAE
Student: CHAN Kwun Fung / AE UROP Course: UROP1100, Fall 2015

Since the 20th century, a population explosion has increasingly hampered food supply. Ensuring adequate food production has thus become crucial. For this, more land should be allocated for agricultural use; in addition, farmers should monitor crops to eliminate unfavorable factors and provide a more favorable environment according to the state of the crops. However, with limited manpower, monitoring crops on a large scale is extremely difficult. An innovative solution should be considered to resolve this issue. This project introduces a system that applies sensing equipment on an airship unmanned aerial vehicle, so that it can identify the state of the crops on a large scale, provide information to farmers, and eventually maximize crop yield.

Advisor: LI Larry / MAE
Student: JHA Animesh Kumar / MECH UROP Course: UROP2100, Fall 2015

With an unprecedented boom in world population, the imbalance between food production and global demand has increased in recent years. Food security is considered one of the most critical concerns, and thus, sufficient technological advancement is required for enhancing food production. Simply increasing the area of land under cultivation is unfeasible because of the growing emphasis on the conservation of the Earth's forest cover. Thus, a more feasible approach will be maximizing the yield in existing areas under cultivation by mitigating losses due to preventable factors, such as localized water shortages, pests, and micronutrient and macronutrient deficiencies, which could be eliminated through active and preemptive monitoring. This project presents the concept of an airship unmanned aerial vehicle, which when equipped with sensing equipment, will be able to detect crop sickness and stresses and transmit this information to farmers, enabling them to take action against crop damage.

Advisor: LI Larry / MAE
Student: SETHI Gursimran Singh / ELEC UROP Course: UROP2100, Spring 2016
Student: TRIPATHI Siddhant / MECH UROP Course: UROP2100, Spring 2016

With the increasing global population, food security has become an extremely critical issue. Ensuring adequate food supply, despite increasing temperatures, less predictable climates, and more extreme weather conditions, is a challenging task requiring innovative solutions. Consequently, direct monitoring of crop health on a large scale would provide a stable crop yield each year. This relatively new area of agricultural remote-sensing enables famers to ascertain the health of individual plants in the field and take action accordingly. This proposal outlines a HKUST project that investigates this cutting-edge technology for application in Hong Kong.

Local Stability Analysis of Confined Shear Flows in Gas-turbine Combustors

Advisor: LI Larry / MAE
Student: FAN Zhiyuan / AERO — UROP Course: UROP1100, Spring 2016; UROP2100, Summer 2016
Student: WANG Luqi / CPEG — UROP Course: UROP1000, Summer 2016

Local stability analysis for gas-turbine combustors is crucial for the efficiency and stability of aircraft engines, and the proper design guided by the analysis can be a great improvement in the aircraft industry. Thus, we are adopting instaflow, a MATLAB-based computational software, to perform local stability analysis. By adjusting the parameters and with appropriate operation, the software will execute and generate results automatically. During the stability analysis, we have encountered a few problems and learned how to fix them. After analyzing the generated results, the linear approximation of the software can be checked to draw further conclusions.

Advisor: LI Larry / MAE
Student: REN Da Wei David / PHYS-IRE — UROP Course: UROP1100, Summer 2016

Recent developments in unmanned aerial vehicle platforms offer an alternative to satellite-based crop imaging for remote-sensing purposes. These platforms generally rely on expensive multicamera setups. We present the efficacy of an ordinary point-and-shoot camera converted to become a multispectral imager for determining crop health in lettuce (*Lactuca sativa* L.). Images of experimentally grown lettuce were used to determine the optimum vegetation index (VI) for this converted imager. Processed images were then used as reference data for an unsupervised expectation minimization Gaussian mixture model cluster algorithm to quantitatively determine the health status of any given *L. sativa* L. Results indicate that blue wide-dynamic range VI (BWDRVI) is the most effective VI for this conversion. Ground-level and oblique imaging indicated similar results through the clustering process.

Unsupervised clustering indicated that BWDRVI most efficiently distinguishes healthy from unhealthy lettuce, even after mixing ground-level and oblique images. Our proposed accuracy index quantitatively supports this view because 88.9% of the original data was corrected and placed into the appropriate clusters. Bootstrap resampling of the raw mixed BWDRVI values with 20,000 resamples further reinforced the efficacy of BWDRVI and two distinct Gaussian curves emerged. The results suggested that the low-cost camera conversion paired with the clustering algorithm determines crop health, potentially increasing the yield of *L. sativa* L.

Keywords—remote sensing, *Lactuca sativa* L., multispectral imaging.

Development of Robotic Assistive Aids for the General Public

Advisor: MA Lok Wang / MAE — Co-advisor: CHAO Yu Hang Christopher / MAE
Student: CHENG Yuet Yee / GBUS — UROP Course: UROP1000, Summer 2016
Student: LEE Harin / MECH — UROP Course: UROP1000, Summer 2016
Student: LU Chengqi / MECH — UROP Course: UROP1000, Summer 2016
Student: SUEN Man Kit / MECH — UROP Course: UROP1000, Summer 2016

In this UROP, our objective was to produce and modify a wheelchair for the powered wheelchair competition in Cybathlon. In this competition, the wheelchair should be able to pass through daily life obstacles, such as slopes, stairs, and bumps. The main feature of our wheelchair is that it uses tracks instead of two large wheels; it also has motors and a linear actuator, allowing it to move spontaneously.

Biomimetic Design of Flexible Flapping Wings for Micro Air Vehicles

Advisor: QIU Huihe / MAE
Student: DONG Zhenyang / AERO — UROP Course: UROP1100, Spring 2016

Flow visualization is a major part of experiments for understanding and developing a flapping-wing mechanism. After considering the limitations of some existing methods, the dye-discharging method is selected, in which a dye emerges from the tunnels inside the wing and forms the flow shape. This method was tested by observing the LEV and TEV of the reciprocating revolving wing. The results show similar phenomena with authentic studies, indicating the effectiveness of this method. After calculating the diffusion rate and color visibility of the wing, this method can provide high flow fidelity and simplicity in operation, but improvements are required for wing production and wastewater reduction.

Advisor: QIU Huihe / MAE
Student: YEUNG Yuk Hing / MEGBM UROP Course: UROP1100, Fall 2015

Increased power efficiency and stabilized flight control impede micro air vehicle (MAV) development. Given the small size and low Reynolds number of MAVs, learning the possible methods and optimizing the aerodynamic design from flying insects might be useful. This project was conducted to study the basic kinematics and wing-wake interaction between the forewing and hindwing of dragonflies through time stereo particle image velocimetry. The experiment was conducted to study the flapping of a regular dragonfly and compare it with the scenario in which the forewing is removed. Results demonstrated that the wing-wake interaction exists between forewing and hindwing, and the effect was more obvious at the inner spanwise region than at the outer spanwise region.

Human Comfort Sensing for Intelligent Building Technology

Advisor: QIU Huihe / MAE
Student: ROTANSON Jason / MECH UROP Course: UROP1100, Spring 2016

Human thermal comfort is most crucial when assessing the performance of the heating, ventilating, and air conditioning (HVAC) system in a building. Engineers should be able to characterize human comfort so that personalized HVAC systems can be developed. This project aims to quantify human comfort by using various sensors and a data acquisition system for personalized HVAC system in a smart building. An experiment is performed to measure the metabolism and heartrate under different activity levels in a prescribed environmental condition. The data obtained can then be used as feedback to better control HVAC systems.

A Hand-held Electromagnetic Energy Harvester

Advisor: YAO Shuhuai / MAE
Student: ZHU Jinwei / MECH UROP Course: UROP1100, Fall 2015

This article briefly considers a possible method of building an energy harvester as an alternative to the traditional electromagnetic approach. Shaking a battery can cause some change to the output voltage of the battery. Based on this phenomenon, we performed some experiments to determine the reason for the voltage change and discussed whether this phenomenon can be used to build an energy harvester. After performing experiments in different conditions, we provisionally assumed that this approach is unfeasible for harvesting energy. However, the constant voltage change can facilitate in developing a type of motion detector related to molecular electronic transducer technology.

Advisor: YAO Shuhuai / MAE
Student: NASTA Ansh Naresh / MECH UROP Course: UROP1100, Fall 2015
UROP2100, Spring 2016
Student: TSANG Kam Fai / ELEC UROP Course: UROP1100, Fall 2015

The purpose of this project was to examine the currently available electromagnetic energy harvesters and to design a new configuration of the harvester for converting kinetic energy from human daily motions, such as walking and running, to usable electric energy for charging or powering portable personal electronic devices.

Modeling and simulations were performed before designing the device. A driving frequency of approximately 3.5–4 Hz could induce the highest root-mean-square value of the voltage output; the peak value corresponding to a driving frequency of 4 Hz was calculated to be approximately 2.3 V for a simple device with both rectangular and elliptical coils. Prototyping and testing was conducted consecutively to test the assumptions and simulation results for providing further insight into iteration of the harvester design. The results were used to develop new prototypes.

Advisor: YAO Shuhuai / MAE
Student: WONG Wai Man / MECH UROP Course: UROP1100, Fall 2015
UROP2100, Spring 2016
UROP3100, Summer 2016

This project report describes the progress from fall 2015 to this semester of summer 2016. The project aims to develop a handheld electromagnetic energy harvester device to charge the mobile through human daily motion, such as walking and running. After three semesters, the basic device was constructed: it could produce approximately 0.6- and 2.4-V output powers at 1 and 4 Hz, respectively. Prototyping and testing was then completed, and the results were obtained through oscilloscope testing. The results fulfilled the project objective, but the output remained an imperfect sinusoid with some harmonics; this must be rectified before providing power to mobile phones; this could be the furture objective of this project.

Developing Nanomanufacturing Methods for Novel Icephobic Surfaces

Advisor: YAO Shuhuai / MAE
Student: XIONG Shuai / MECH UROP Course: UROP1100, Fall 2015

This project primarily focuses on the fabrication of hybrid icephobic surfaces that can retard frost formation and accumulation, which is of great importance to various engineering systems. Although traditional superhydrophobic surfaces promote self-removal of condensed droplets, they are extremely sensitive to thermal fluctuation, thus resulting in significant and irreversible frost formation. Here, we propose a scale-up fabrication technique of hybrid nanostructured surfaces with patterned high wetting contrast by using electrospray, enabling heterogeneous ice nucleation and preventing the unwanted frosting phenomena in the air conditioning system. This report discusses the detailed implementation and methodology of microscale masking through the use of electrospray and its further usefulness in terms of hybrid surface manufacturing by using anodization methods.

Keywords—electrospray, Taylor cone, anodization, nanofabrication, hybrid icepobic surface.

Advisor: YAO Shuhuai / MAE
Student: YAO Yuan / MECH UROP Course: UROP1100, Fall 2015
UROP2100, Spring 2016
Student: JHA Animesh Kumar / MECH UROP Course: UROP1100, Spring 2016

The objective of this project was to study nanomanufacturing techniques for superhydrophobic surfaces, achieved by the presence of hydrophobic nylon surfaces amongst hydrophilic nanostructures on copper and aluminum surfaces. Anodization methods for developing nanostructures were studied, along with suitable pretreatment electropolishing methods. Moreover, the survivability of the nylon-masking on metal surfaces through the anodization process was studied and anodization techniques were developed to ensure survivability. After studying and testing numerous methods for the aforementioned processes, experimental procedures and parameters suitable for achieving the objectives were determined.

Keywords—electrospray, anodization, hybrid icephobic surface, electropolishing, condensation enhancement.

Geometry Induced Droplet Self-Breakup for On Chip Droplet based Digital Polymerase Chain Reaction

Advisor: YAO Shuhuai / MAE
Student: CHAN Ka Hung / SENG UROP Course: UROP1100, Summer 2016

Several counting programs are available currently; however, these cannot count under cells at a high density. The purpose of this counting program is to count cells with the least error. The idea of this simple counting program is based on some general properties of cells. However, this program is not perfect because it cannot handle some special cases. Several possible improvements can be implemented to enhance the accuracy and our future direction could focus on the simplification of photos to make analysis easier. A comparative method can be used if the simplification method cannot significantly improve the accuracy.

Advisor: YAO Shuhuai / MAE
Student: YAU Ting Wai / SENG UROP Course: UROP1000, Summer 2016

This report details the progress of the research on the digital thermocycler for PCR. It first describes the components, structures, circuits, and coding used for the thermocycler prototype and then indicates the associated problems encountered and their potential solutions. Prototype testing confirmed the successful development of circuit and LabVIEW code and the limitations of existing heater and cooler, thus providing a solid foundation for the progress of the integrated system by developing the microcontroller and PCB in the future and by using the information collected for selecting a suitable heater and cooler.

Optical Mapping of Genomic DNA from Single Cell in a Nanofluidic Device

Advisor: YAO Shuhuai / MAE
Student: SO Kam Pang / MEGBM UROP Course: UROP1100, Spring 2016
UROP1000, Summer 2016

Nanocomposite formed by polymer and carbon nanotubes (CNTs) has been widely used in the biology field in recent years. This project aims to continue the steps performed in the previous semester and regenerate the nanocomposite presented in previous papers. Different recipes have been used and tested. In the previous semester, the trials failed to complete the final product. The polymer and CNT mixture could neither solidify nor conduct electricity. In this semester, the recipes have been divided into different steps for debugging. Our final objective is to eliminate the ambiguity in the reference papers and create an optimum protocol in the laboratory.

Study of Defrosting on Nanostructure Surfaces under the Acoustic Effect

Advisor: YAO Shuhuai / MAE
Student: FENG Chenxi / MECH UROP Course: UROP4100, Fall 2015
Student: ZHOU Peng / MECH UROP Course: UROP3100, Fall 2015

Nanostructured surfaces play a critical role in energy conversion devices; however, the effects of different nanosurfaces have not been compared systematically. In this project, we tested and developed several methods to fabricate Al_2O and CuO nanosurfaces in a simple commercial way. All these nanostructures on a fabricated surface had a favorable orientation, thus suggesting the superhydrophobic nature of the structures. In addition, the vacuum chamber used for the testing surface has been developed, and the recent progress has been reported here. Vapor generation and the cooling system have already been designed and tested and have presented great potential and reliability. The overall leaking rate of the chamber is also controlled at a reasonable level. All these preparations have been created through the effort of every group member; the relevant experiment will be conducted soon.

Advisor: YAO Shuhuai / MAE
Student: ZHANG Zihang / MECH UROP Course: UROP1100, Fall 2015
UROP2100, Summer 2016

Because of their high condensation rate, superhydrophobic nanostructured surfaces demonstrate favorable performance in energy conversion devices. This is because the structure enables the droplets to jump off the surface, thus producing continuous and effective condensation. However, the drop-off rate remains low and the condensation rate has not increased. Here, the electrospraying method was used to enhance the performance of the superhydrophobic nanostructured surface, because spraying nylon can generate a mask; by further fabrication, a surface can form, which is alternately hydrophilic and hydrophobic. The condensed water is more likely to gather on the hydrophilic part because of low surface energy and drop off, thus increasing the condensation rate.

Development of an In-situ Health Monitoring System for Composite Aircraft Panel

Advisor: YE Wenjing / MAE
Student: POON Yun Man / MECH UROP Course: UROP1000, Summer 2016

This report presents the progress of the ongoing project “Development of an In-situ Health Monitoring System for Composite Aircraft Panel,” with the experimental objective of analyzing the electric signals by using piezo transducers. Signal sensing and presentation has been primarily validated with the effort on noise reduction in the aluminum plate in use. The need of signal amplification has been addressed, considering the indistinct response from direct signal generation to the piezo actuators. After employing a voltage amplifier, further work will be performed for complete wave transmission and identifying defects or flaws in the solid structure. The final objective for this study is to implement this onboard monitoring approach in aerospace areas.

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SCHOOL OF BUSINESS & MANAGEMENT

Department of Economics

Firms in Globalization: Evidence from China

Advisor: LI Yao / ECON
Student: FU Wai Ming / GBUS UROP Course: UROP1100, Fall 2015

This report summarizes the proceedings and findings of our UROP 1100G project "Firms in Globalization: Evidence from China" in Fall Semester 2015. With the rapid growth in China's technology sector, patent has become essential for promoting innovation and protecting investors' property rights. By using the patent information in China, this project examines the economic behavior of foreign direct investments (FDIs) and Chinese indigenous enterprises (CIEs). Our role entails data processing on two respective data sets of FDIs and CIEs as well as data cleansing. We have cleaned the data of the preceding year and corrected some of the errors in the data set. We have also preprocessed both the FDI and CIE data sets, ensuring their relevance for future research.

Advisor: LI Yao / ECON
Student: HAO Yijun / ECOF UROP Course: UROP4100, Fall 2015

As a continuation of last summer's project, during this semester, we focused on the significant role of exporting zones in the development of China's economy. The main task was to improve the quality of the town-level data set constructed in the preceding summer. The data set had three main problems: relatively high missing rate of addresses, inconsistency of the firm address over the years, and incorrect matching between towns and counties. To overcome these issues, we began with widely applied commands. However, the results were unsatisfactory; hence, we decided to use manual checking process to further improve the result quality.

Advisor: LI Yao / ECON
Student: HAO Zaijie / ECOF UROP Course: UROP2100, Fall 2015
Student: OUE Kai Chung / ECOF UROP Course: UROP3100, Fall 2015

The TIF database contains information from Taiwan invested firms in China. In this project, we refined a more proper database to explore the percentage change in some factors, including parental R&D information and affiliates' R&D information toward the intermediate costs of the TIF database. Based on the TIF database (2000–2009) processed previously, we classified the product type each year in the current database and included the relevant tariff record (1997–2009) to more efficiently construct the database for the regression model.

Advisor: LI Yao / ECON
Student: KAN Chen / ECOF UROP Course: UROP4100, Fall 2015

The skill level in Chinese labor markets has improved greatly. The number of college graduates has been increasing over the years. However, what is the general pattern for each industry? Does every industry have the same increase in skill level? Furthermore, the service sector contributes increasingly to the entire economy, and the skill level is extremely significant in determining the growth of the whole industry. Therefore, we are investigating the structure change of the skill level in the service sector. In this semester, we mainly focus our research on this project.

Advisor: LI Yao / ECON
Student: LEE Tsz Him / ECOF UROP Course: UROP2100, Fall 2015
UROP3100, Spring 2016

In this report, I summarize the findings of my project in the spring semester of 2016 under Prof. Li's supervision for the project "Firms in Globalization: Evidence from China." My major focus is on China patent data. With these patent data, we examined the economic behavior of foreign direct investments and Chinese indigenous

enterprises by relating them to their patent behavior. With the data from previous work and groups, I have related them with their states and investigated the effect of these patent data on these states.

Advisor: LI Yao / ECON
Student: XING Eva / MAEC — UROP Course: UROP1100, Fall 2015; UROP2100, Spring 2016
Student: XU Jun / ECON — UROP Course: UROP3100, Spring 2016
Student: ZHANG Chuyue / ECOF — UROP Course: UROP2100, Fall 2015; UROP3100, Spring 2016

The customs database contains information from Taiwan invested firms in China for different years. In this project, we refine the trading record of the customs data from 2000 to 2007. Different variables of the firm and product levels are to be provided and included yearly, according to the CRC code in the original customs data. We also must provide a list of Chinese names of the firms based on the CRC code—both simplified Chinese names and possibly Taiwan traditional Chinese names. Based on the data processed before, we can add the Chinese names of the firms according to the CRC code to a new Excel file and merge the records of the product level from 2000 to 2006 through the CRC code by using merged results of both the provided product levels and customs data.

Middle-Income Trap, Structural Change, and Economic Growth

Advisor: WANG Yong / ECON
Student: CHEUNG Wai Ho / ECOF — UROP Course: UROP2100, Fall 2015
Student: PEI Ling / MAEC — UROP Course: UROP1100, Fall 2015
Student: ZHANG Tina Danting / MAEC — UROP Course: UROP1100, Fall 2015

This report presents our findings related to assumptions and predictions of the model for this project. We observed a positive relationship between consumption services shared in GDP and income, supporting the assumption that consumption services expand as income increases. We also found that high-quality manufacturing and consumption services require more production manufacturing and specific production services input more than basic-manufacturing, consistent with the model's assumption. For model prediction, we compare production services shared in GDP and in total value-added services of middle-income escapers and trappers as well as low-income escapers and trappers.

Advisor: WANG Yong / ECON
Student: LI Meiyi / ECON — UROP Course: UROP1100, Spring 2016
Student: LIU Yuhong / ECOF — UROP Course: UROP1100, Spring 2016
Student: MA Yuanxiang / ECOF — UROP Course: UROP3100, Spring 2016
Student: WONG Tak Sing / GBUS — UROP Course: UROP1100, Spring 2016
Student: ZHOU Kairuo / MAEC — UROP Course: UROP1100, Spring 2016

The work summarized in this report mainly follows the final report of Fall 2015, where middle-income trapped (MT) and middle-income trap escaped (ME) countries were redefined using a more complete definition. With this new definition, we updated some supporting facts in the project and also resolved problems from the previous report. Efforts were also made for finding more suitable measurements of production service development and studying entry barriers to the sector.

Regional Inequality and Economic Growth: An Open Economy Perspective

Advisor: WANG Yong / ECON
Student: YANG Yuan / MAEC — UROP Course: UROP1100, Spring 2016

Regional inequality in China has gained the interest of scholars. This study reveals the disparities in structural change among several representative cities by analyzing economic data. Moreover, we attempt to find

explanations for the inequalities. First, the employment in primary, secondary, and tertiary industries and their corresponding proportions are compared. The changes in value-added services of the three industries also indicate the structural change. In addition, we examine the land allocation among different cities, trying to find the connection between land allocation and structural change.

Keywords—regional inequality, structural change, land allocation, economic growth, China.

Department of Finance

Top Management Turnover and Corporate Policy Decisions

Advisor: GOYAL Vidhan Krishan / FINA
Student: CHOW Ho Ming Henry / QFIN UROP Course: UROP2100, Fall 2015

To investigate the association between CEO power and entrenchment and Key Enterprise Retention Plan (KERP) adoption, we collected 135 samples of companies filing for bankruptcy. For sample companies with adopted KERP, we identified the executive during the KERP occurred along with other demographic details of each individual. For sample companies with no KERP adoption, we identified the executive rights before Chapter 11 filing. In a 3-month timeframe, we consolidated most data points and generated statistically significant results to support the thesis.

Advisor: GOYAL Vidhan Krishan / FINA
Student: GUAN Chun / ECOF UROP Course: UROP1100, Fall 2015

The purpose of this UROP project is to valuate companies by analyzing available information. With HP and Compaq M&A case package, FCF model was used to forecast the value of this project, and data tables were used to visualize the results under different assumptions. With the support of the model, a view was formed that Compaq as a standalone company was overvalued by approximately $5; however, the M&A project would add value of approximately $5 to Compaq. As the market price of Compaq continued to decrease after the M&A announcement, it seemed that the market over reacted, and the merger was a beneficial and wise decision for HP.

Advisor: GOYAL Vidhan Krishan / FINA
Student: HE Jieyan / MAEC UROP Course: UROP1100, Fall 2015

In this paper, I summarize the main results presented by four groups of researchers, concerning the reasons behind firms' decisions to issue abroad and thus hold foreign debt, in terms of both firm-level characteristics and country-based factors. Further the situations of developing and developed countries, extracted and consolidated from different literature, will be compared. Finally, I will mention some potential topics that could be further looked into and could contribute to the understanding of firms' financing decisions.

Climate Finance

Advisor: LAFON-VINAIS Veronique J A / FINA
Student: FANG Zheqi / MAEC UROP Course: UROP1100, Summer 2016
Student: YAO Qiyou / ECOF UROP Course: UROP1100, Summer 2016

Given the international community consensus on climate change and the irreversible trend of developing green economy, fossil fuel sector and utilities sector face a challenge of long-term transformation in the global energy economy. The project focused on potential risks to the Asia financial system brought by companies in these two sectors. In this study, we analyzed the debt structure of two typical companies, CLP and CNOOC, and risk exposures of Asian financial institutions. We collected data from Bloomberg Terminal, Thomson Reuters Eikon, LoanConnector, and MTN-i. We analyzed data from the bond market, loan market, and private placement for three perspectives. We concluded that though the risk level in the Asian financial system is under control, it is necessary to remind investors and Asian financial institutions to enhance risk awareness and anti-risk capability.

Corporate Risk Management Practices: Global Survey of BRICS-Country Firms

Advisor: MACKAY Peter / FINA
Student: ZHANG Yanjia / QFIN UROP Course: UROP3100, Fall 2015

A survey of several benchmark countries is essential for the comparison. This progress report presents the final step of the survey-planning stage of the project and a transition to the next phase. The report details the assistance provided by the participant in the survey-planning stage, including data clearing of the contact information and converging the addresses with Mail Merge. Thus far, under the supervision of Prof. Peter Mackay and with the collective effort of Lucas, Grace, and Alex, the respondents' data have been completed and reformatted, and an online questionnaire based on Qualtircs has been created. The project is ready to enter the next stage in Spring 2016, where questionnaires will be sent, responses collected, and data analyzed.

Advisor: MACKAY Peter / FINA
Student: ZHAO Yunwei / ECOF UROP Course: UROP1100, Fall 2015

This report discusses the work done for project A "Corporate Risk Management Practices: Global Survey of BRICS-Country Firms" and project B "Corporate Risk Management: What Can We Learn from Financial Statements?" For project A, I mainly focused on the development of the questionnaire on the online survey platform Qualtrics. For project B, data collection and data set update were performed. In the subsequent stage, we would finalize, translate, and distribute the questionnaire from project A.

Advisor: MACKAY Peter / FINA
Student: CHEUNG Yan Yin / GBUS UROP Course: UROP1100, Spring 2016
Student: EKAPUTRA Nicholas Michael / RMBI UROP Course: UROP1100, Spring 2016
Student: FENG Shuo / RMBI UROP Course: UROP1100, Spring 2016
Student: WANG Ziyi / RMBI UROP Course: UROP1100, Spring 2016
Student: ZHANG Jingting / QFIN UROP Course: UROP1100, Spring 2016

This project is the first large-scale comparative analysis of corporate risk-management practices of firms domiciled or operating in the BRICS countries. It aims to determine how a company in a BRICS country would prepare and respond to potential risks. A questionnaire would be the main tools to ask and collect data from firm officers in BRICS countries as well as that in developed countries (used as a benchmark). The project comprises five main stages: survey planning, survey execution, data analysis, report writing, and result dissemination. The report begins with our understanding of this project, its significance, and our implementation progress and then discusses our effort this semester and relevant techniques involved in data cleaning and survey planning. Finally, the ongoing plan and thoughts of team members are mentioned.

Advisor: MACKAY Peter / FINA
Student: EKAPUTRA Nicholas Michael / RMBI UROP Course: UROP1100, Spring 2016
UROP2100, Summer 2016
Student: TONG Ka Ho / ECOF UROP Course: UROP1100, Spring 2016
UROP2100, Summer 2016

This project is the first large-scale comparative analysis of corporate risk-management practices of firms domiciled or operating in the BRICS countries. It aims to determine how a company in a BRICS country would prepare and respond to potential risks. A questionnaire would be the main tools to ask and collect data from firm officers in BRICS countries as well as that in developed countries (used as a benchmark). The project comprises five main stages: survey planning, survey execution, data analysis, report writing, and result dissemination. The report begins with our understanding of this project, its significance, and our implementation progress and then discusses our effort this semester and relevant techniques involved in data cleaning and survey planning. Finally, the ongoing plan and thoughts of team members are mentioned.

Corporate Risk Management: What Can We Learn from Financial Statements?

Advisor: MACKAY Peter / FINA
Student: PARK Jungjae / GBUS UROP Course: UROP1100, Fall 2015

The UROP 1100 titled "Corporate Risk Management: What Can We Learn from Financial Statements?" by Prof. Peter Mackay determines what risks firms hedge for, how much they hedge, and corporate risk management by considering the financial statements of companies. My work focused on collecting 2014 data on hedging from financial statements. However, not all 34 firms we focused on provided detailed data on hedging, and some of the companies were either merged with another company or had disappeared. This research paper studies the data on hedging collected from 2014 financial statements and clarifies the reason that some of the companies have disappeared.

The Impact of Emigration of Controlling Shareholders on Firm Value and Corporate Decisions

Advisor: WEI Kuo-chiang / FINA
Student: GAO Baiwen / QFIN UROP Course: UROP3100, Fall 2015
Student: KIM Jae Woo / QFIN UROP Course: UROP2100, Fall 2015
Student: LIN Yiwei / QFIN UROP Course: UROP4100, Fall 2015
Student: LIU Xiaoyan / QFIN UROP Course: UROP1100, Fall 2015
Student: ZHANG Jingting / QFIN UROP Course: UROP1100, Fall 2015

The trend of globalization has flattened the world, affecting the economy through various channels, such as market integration and multivariate free trade promotion. Furthermore, the evolution of some human behaviors under a new environment can also have subtle yet critical implications on the commercial world, of which emigration can be a typical example. In many developing countries, outgoing immigrants are generally considered the affluent cohort with a strong economic background to afford the huge expenditures in the emigration process and life abroad; a large proportion of these people even have their own enterprises. In addition to seeking for a more regulated investment environment, higher life quality, and more favorable education resources for children, emigrates are sometimes accused of unfavorable motivations, such as avoiding obligations and engaging in corporate fraud. We examined relevant policies in several countries toward companies with controlling shareholders who have foreign residence information to determine whether such privileges exist and some implications for policies. In addition, we collected information concerning the time of immigration of controlling shareholders and their behaviors in their firms to explore the correlation between these factors. After the estimation, we expect to determine the relationship of the effects of immigration on firm value and other aspects; this relationship might also affect firm value. Based on the progress of the research thus far (previous semester), we are now focusing on other aspects.

Department of Information Systems, Business Statistics & Operations Management

Dynamics in Crowd-based Contests

Advisor: KOH Tat Koon / ISOM
Student: LO Tsz Hin / RMBI UROP Course: UROP1100, Fall 2015

The Open Contest aims to attract as many participants as possible so that a company can have a higher chance to receive excellent solutions. Scholars suggested that these contests should have more prizes whereas some should not because these do not consider participants' risk levels. Participants with different risk levels toward the conditions of the contests select different types of contests and determine how much effort to put in. This research can reconcile the contradictions between scholars, clarifying the discrepancies of previous research. Furthermore, companies can employ the concepts to better design the Open Contest and maximize participation and aggregate effort, thus achieving the most favorable outcomes.

Advisor: KOH Tat Koon / ISOM
Student: MAK Hiu Laam Vanessa / ACCT UROP Course: UROP1000, Summer 2016

Crowd-based contests are becoming increasing popular, both for companies to find solutions at a lower cost and for researchers to study and suggest how to improve mechanisms so that the process would bring more value to stakeholders on the crowdsourcing platform, particularly seekers (generally companies). Here, the concepts of crowdsourcing and the halo effect are introduced, followed by a discussion of the possible influence of the halo effect in crowd-based contests, and whether the halo effect can alter the judgment of the contest participants with feedback from a seeker. Toward the end of the report, some practical implications are also discussed.

Advisor: KOH Tat Koon / ISOM
Student: QI Tong / SBM UROP Course: UROP1000, Summer 2016

To stay updated with the trend of crowdsourcing, we want to further use this online community platform for the most efficient work process to obtain most favorable results among a large group of participants. In our project, we reviewed numerous papers regarding contest design and decision-making under risk and uncertainty. This report first introduces the influence of different contests and then analyzes people's decisions and effort allocation under risk and uncertainty. The majority of people are risk-averse; thus, we also assume that average contestants are risk-averse in analyzing their preferences. By comparing different contest designs, participants' decisions and behaviors under risks and uncertainty, we will finally draw a conclusion on how to maximize the outcome for seekers in a crowdsourcing contest.

Financial Modeling with VBA and R

Advisor: KWOK James Sai Ho / ISOM
Student: LI Anni / QFIN UROP Course: UROP1100, Spring 2016

This project analyzes the implementation of fundamental and technical analyses in the stock market, with a focus on the airline industry; the project concludes that technical analysis is required when finance and economy factors flatten and uncertainty of predicting the company performance mainly depends on company inner decisions. The technical analysis would use buy-and-sell strength comparison; this report states the recommended indicators and corresponding bands for maximizing signal amount accuracy and prediction accuracy.

Advisor: KWOK James Sai Ho / ISOM
Student: BAI Xue / MAEC UROP Course: UROP1100, Summer 2016

This paper first explained the reason for selecting fuzzy logic systems as the research object. Then, it emphasizes the importance of fuzzy logic systems in the development of financial models of stock prices by conducting an in-depth literature review. In part 3, based on a prototype model developed in 2015 by simplifying and combining selected rules, an improved model is derived. The proposed algorithm integrates three commonly used technical trading rules with fuzzy logic systems into excess demand functions to predict future stock price trends. Based on the expected future movements of the stock price, suggestions of buying or selling and its size are made by the model.

Keywords—technical trading rules, technical indicators, fuzzy logic systems, trend analysis.

Advisor: KWOK James Sai Ho / ISOM
Student: HUANG Silin / MAEC — UROP Course: UROP1100, Spring 2016, UROP2100, Summer 2016
Student: MA Jiaxin / IELM — UROP Course: UROP1100, Spring 2016, UROP2100, Summer 2016

The artificial neural network (ANN) has been extensively used in many fields including character recognition, image compression, and search result optimization for its ability to solve complex classification, pattern recognition, and forecasting problems with relatively simple computational operations. It is progressively popular among researchers in the field of technical analysis for stock market prediction and has a promising future in deciphering the convoluted price changes in the stock market. This paper proposes an effective methodology for applying ANN in next-day stock price prediction, providing a comprehensive solution from input selection with stepwise regression analysis (SRA) to the detailed implementation of an iterative training-predicting process. Our experimental results on the stock of the Hong Kong and China Gas Company Limited (0003.HK) confirm the practicality and efficacy of the proposed mechanism with relatively high predication accuracy.

Advisor: KWOK James Sai Ho / ISOM
Student: ZHU Yanqi / QFIN — UROP Course: UROP1100, Spring 2016

This research paper mainly focus on the optimization of the existing RSI trading rules, which are more efficient and accurate in the stock market. When we are using RSI and we use the basic rules to determine the overbought and oversold point. However, some potential problems regarding behavior continuation and frequency of the signal appearance are reported. To solve this problem, I performed a literature review of the RSI existing models, executed the current models in programming and propose two modified models based on the existing ones to tackle these concerns.

Big Data Analytics

Advisor: SO Mike Ka Pui / ISOM — Co-advisor: TAM Kar Yan / ISOM
Student: LIU Kam Leung / RMBI — UROP Course: UROP1100, Spring 2016

The area of network analysis has been growing rapidly because of the abundant network data generated since the emergence of different social networking platforms. Several efforts have been put into this area to fulfill the high demand for analyzing such networks to gain valuable insights. This report comprehensively reviews the typical network data analytics methods from the perspective of statistics, ranging from network visualization and descriptive measures to inference and modeling of network processes. They are mainly designed for static networks. Finally, some strategies for analyzing dynamic networks are discussed.

Advisor: SO Mike Ka Pui / ISOM — Co-advisor: TAM Kar Yan / ISOM
Student: LO Tsz Cheung / COMP — UROP Course: UROP1100, Spring 2016

The semester UROP is similar to a reading course, providing me an opportunity to go through diverse topics regarding exponential random graphs (p*) under the popular concept of big data and facilitating me in preparing

for further research or industrial practice. This report is a well-combined version of my weekly reports summarizing the materials I went through for the paper "An introduction to exponential random graph (p*)."

Advisor: SO Mike Ka Pui / ISOM Co-advisor: TAM Kar Yan / ISOM
Student: YANG Ziqi / QFIN UROP Course: UROP1100, Spring 2016

A copula is a multivariate probability distribution with a uniform marginal distribution for each variable. It studies the link among different variables for constructing bivariate distributions and measuring dependence. Copulas have been increasingly used in many areas for investigating dependence (e.g., finance), and they are extremely useful in risk and portfolio management. They can be used to conduct stress tests and adapted to estimate the losses on portfolios containing different assets. In addition, system sustainability analysis, weather prediction, medicine analysis, and many other fields rely heavily on copula techniques.

Risk Management

Advisor: SO Mike Ka Pui / ISOM
Student: CHAN Tsz Lok / RMBI UROP Course: UROP1100, Spring 2016

This research is in the preparation stage. Thus far, no formal topic has been allotted for our research because our supervisor expects students to extend the research period into a year and a longer duration even. The textbook "An introduction to Copula," written by Roger B. Nelson, related to copulas—a statistical term describing joint distribution between different univariate distributions and the variable in term of the probability distribution value—has been provided to me for reading. I have read the textbook until chapter 4. The following content is in the format of a progress report in an ascending order of date.

Intermediate Quantitative Trading

Advisor: ZHANG Xiaoquan / ISOM
Student: LI Yutong / QFIN UROP Course: UROP1100, Fall 2015

In this quantitative trading research project, I first gradually learned to use R programming by following some online courses. I found the language to be quite useful and powerful in terms of graphics and trading strategy back testing. I developed a trading strategy with the momentum trading style in ETFs. I tested whether following momentum outperforms the benchmark, and if yes, how the strategy can be further improved through appropriate diversification.

Application of Topic Modeling in Recommender Systems

Advisor: ZHENG Rong / ISOM
Student: WANG Li / SBM UROP Course: UROP1100, Summer 2016

The project aims to apply topic modeling to the study of evolution in business journals through time. The research takes the top ranked business journals at the University of Texas at Dallas as the main study objects and adopts the latent Dirichlet allocation model as the method to extract the information of documents of the journals and deduce their topics. Although the following work of data analyzing is still in process because of data collection difficulties in the first stage, the primary preparation of materials and knowledge of the method has been acquired to date. This is a progress report for the work performed in the summer period for the research of application of topic modeling for topic change in business journals.

Keywords—business journal, topic modeling, LDA model, topic change.

Department of Marketing

Mindsets, Emotions and Moral Conviction: Implications for Prosocial Behavior

Advisor: ADAVAL Rashmi / MARK
Co-advisor: SALUJA Geetanjali / MARK
Student: YUAN Xinyu / ECON
UROP Course: UROP1100, Summer 2016

Consumers' mindsets (i.e. outcome-focused or cause-focused) and their feelings of responsibility can affect how they handle the emotions that are elicited when they process information in public-service advertisements. This, in turn, can lead to different ethical behavior intentions. In the present study, we manipulate how responsible consumers feel about damaging the environment, thus affecting how guilty or angry they feel. Consumers who felt responsible for the environmental degradation (i.e., guilty) were likely to shift the blame to others (i.e. support a petition to fine companies) regardless of whether they focused on the outcome or the cause of the action. This presumably occurs because they are aware of their guilt in either case and attempt to rid themselves of the unpleasant feeling state by blaming others. However, consumers who felt angry because they were not responsible for the environmental problem were only likely to blame others when the cause of the environmental degradation was clear. Alternate explanations and future studies are also discussed.

Consumer Food Decision Making

Advisor: MUKHOPADHYAY Anirban / MARK
Co-advisor: HUH Young Eun / MARK
Student: CHEN Weiwei / MARK
UROP Course: UROP1100, Spring 2016

This report mainly comprises the summary for the academic papers reviewed for "Consumer Food Decision Making" under UROP1100 during Spring 2016. Although the reviewed papers share the same topic under food consumption, the subtopics vary among the wide spectrum of fitness branding to effective incentives. It was inspiring for me to gain experience through more exposure to the academic and theoretical area of marketing beyond the business side. The knowledge included marketing experiment design and ANOVA test, which further developed my understanding in the marketing subject area. "Consumer Food Decision Making" was a cooperative project conducted by Chen and Lukman, with help from Chan and Ku, under the supervision of Profs. Anirban and Young.

Advisor: MUKHOPADHYAY Anirban / MARK
Co-advisor: HUH Young Eun / MARK
Student: JIO Rina Lookman / ECOF
UROP Course: UROP1100, Spring 2016

This research project is a continual intended project, which allows student without a marketing and research background to learn step by step in each semester. Spring 2016 is the first semester of the project "Consumer Food Decision Making," which is dedicated to providing a deeper understanding of food marketing. A paper is assigned to each student to read every week and then share their summarization and review of the paper in their subsequent weekly meetings. After gaining deeper understanding in the field and research procedure, students are encouraged to seek potential research topics to conduct research in the next semester.

Department of Management

Equity Crowdfunding in China

Advisor: GARG Sam / MGMT Co-advisor: TSAI Kellee Sing / SOSC
Student: SHI Jiangnan / ECOF UROP Course: UROP1100, Fall 2015

Crowdfunding has become one of the most popular financing modes in Mainland China. It mainly includes equity crowdfunding, donation-based crowdfunding, debt-based crowdfunding (P2P), and reward-based crowdfunding. Among these, equity crowdfunding has boomed rapidly and become increasingly prevalent among innovative start-ups. Thus, this project focuses on equity crowdfunding to study its function and the reasons for its remarkable boom in Mainland China. The project draws upon mostly primary resources, including interviews conducted with major participants in equity crowdfunding, online published reports, and data collected from online crowdfunding platforms. As a starting point for this project, we have obtained valuable information by interviewing five respondents and analyzing the reports from online equity crowdfunding platforms. These studies show the crucial role of equity crowdfunding in the Chinese economic market and imply its future trends of development.

Advisor: GARG Sam / MGMT Co-advisor: TSAI Kellee Sing / SOSC
Student: HU Xinyu / QFIN UROP Course: UROP1100, Spring 2016

Despite the growing attention toward equity crowdfunding in China, little is known about the situation after crowdfunding. What is the relationship between companies and investors? What are the methods for information disclosure and funds management? Are there any challenges faced by this industry and what are the potential solutions? We attempted to answer these questions by interviewing representatives from crowdfunding platforms, project initiators, and investors. Interviewing these three main parties involved in equity crowdfunding indicated that after-crowdfunding management has just begun developing in China. All three parties are taking action to overcome the challenges, as discussed in this report.

The Impact of Technology and "Globalization" on an Individual's Behaviors in an Organization

Advisor: YEUNG Wai Mun Lucia / MGMT
Student: TAN Hui Min / SBM UROP Course: UROP1100, Spring 2016

This research explores how technology such as social media, Skype, and emails, and globalization such as interaction and exposure to various cultures through internships, working holidays, and student exchange programs, affect the development of an individual's mental programs. The potential contribution of this research will help managers to understand and predict behaviors of employees from this generation of fast-track advanced technology and frequent exposure to global values and cultures. Throughout this course, I have learned to search and screen for relevant journal articles related to the research topic, to read journal articles in efficient ways and to synthesize essential findings from the journal articles.

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SCHOOL OF HUMANITIES & SOCIAL SCIENCE

Division of Humanities

Korean War Prisoners Oral History Interview Transcription

Advisor: CHANG David Cheng / HUMA
Student: XIE Xinyi / DBM UROP Course: UROP1000, Summer 2016

As the Second Sino-Japanese War ended in 1945, conflicts between the Chinese Nationalist Party (KMT) and the China Communist Party (CCP) intensified, inevitably developing into the second phase of civil war from 1946 to 1949. Involved in the war as a Chinese Nationalist soldier, Mr. Tao Shan Peng was captured by the CCP when the KMT retreated to southwest China and was sent to fight in the Korean War, in which he managed to escape. The oral history narrated by Mr. Tao allowed us to glimpse those turbulent years; Mr. Tao's precise memory and unique thoughts as a survivor of the times add value on his experience. This report comprises two parts: the outline of Tao's story in chronological order (which would cover the major events in the transcription) and a simple analysis on two features with regard to CCP's governance based on what Mr. Tao experienced or witnessed.

Division of Social Science

Political Economy of the International Monetary Fund

Advisor: CHO Hye Jee / SOSC
Student: CHEUNG Ka Ki / GCS — UROP Course: UROP1100, Fall 2015

This paper examines the conditionality in lending programs of the Philippines, Indonesia, South Korea, and Thailand during the Asian Financial Crisis. The lending countries, where these conditionalities required the institution of new laws, showed the highest delayed or waived percentage, because of the following reasons. First, the process of legislation increases the probability of having a delayed or waived status by making the governments and lending programs more vulnerable to the intervention of other interest groups. Second, the instability of political environment weakens the government's power in controlling interest groups or pushing the legislative branch, affecting the efficiency in implementing the legislative conditionality. The nonlegal binding of the IMF has also affected the aforementioned efficiency by making punishment impossible and lowering the legitimacy of the IMF for monitoring or forcing the countries to implement a conditionality. The transparency problem of the IMF has also contributed to the delayed or waived grant of the legislative conditionality by weakening the confidence of the public and other stakeholders in the country; this can cause difficulty in gaining agreement from interest groups, worsening the problem of the legislative branch in getting consensus.

Advisor: CHO Hye Jee / SOSC
Student: PURI Ajay / ECOF — UROP Course: UROP1100, Fall 2015

This paper highlights how differences in governance systems affect the implementation of IMF conditions by comparing the willingness of leaders to implement these conditions. The goal is to present a defense of democracy as the system that is more likely to implement these conditions. The report analyzes the borrowings of Indonesia, a dictatorship, and Thailand, a democracy, after the 1997 Asian financial crisis and highlights how Thailand was more successful in implementing conditions related to privatization and increasing transparency. The report highlights why the cost of implementation is higher for dictators and how this impedes them from implementing conditions. This is contrasted with an examination of why democratic leaders, despite legislative constraints, are more willing to implement reforms.

Economic Development, Pollution and Health in China

Advisor: HE Guojun / SOSC
Student: CHUNG Wai Chu / ECOF — UROP Course: UROP1100, Fall 2015
HO Lok Yin / ECOF — UROP1100, Fall 2015
MAN Tingjun / ECOF — UROP1100, Fall 2015

This entire project is divided into three specific areas of interest: air pollution and health, water pollution and health, highway expansion and pollution. The first two topics aim at understanding the association between pollution variation and mortality for major Chinese cities or regions and developing a corresponding health index based on the estimates, while the third topic aims to investigate the relation of economics development in China and pollution. We were mainly engaged in water pollution and highway expansion projects and conducted data collection as well as data cleaning. The details of all the tasks, followed by a conclusion, are presented below, with the names in the subtitles indicating our participation on respective projects.

Advisor: HE Guojun / SOSC
Student: BALASUBRAMANIAN Sneha / EVMT — UROP Course: UROP1100, Spring 2016

This project aims to understand the complex relationship between economic development, environmental quality, and human health in China. Comprehensive data on air pollution, water pollution, and health in China are being

used to further understand how these factors interact. In particular, this project focuses on the effect of the expansion of expressways on the firm's polluting behaviors in China. (An expressway is an urban motorway, especially created for high-speed traffic to provide uninterrupted, smooth mobility between major points.) This project is based on a hypothesis that because the major cities value environmental quality more than the smaller counties do and have a higher willingness to pay for a cleaner, safer environment, pollution-intensive industries move from the cities to the counties, along the expressways, thus polluting small counties along the way. This project aims to determine the level of pollution and its effects that the counties along with the expressway experience.

Advisor: HE Guojun / SOSC
Student: DAI Anna / MATH-AM UROP Course: UROP1100, Summer 2016

In the UROP "Economic Development, Pollution, and Health in China," I learned from past papers regarding pollution in China, drafted a new article based on a relevant paper, and cleaned data for the future research. This article records and summarizes the learning outcomes, which are divided into three parts: The first includes several bullet points for writing a convincing quantitative article; the second introduces the reason, methods, and concerns for popularizing the research findings; and the third talks about some insights of the data analysis procedure.

Advisor: HE Guojun / SOSC
Student: LI Na / FINA UROP Course: UROP1100, Summer 2016

Our project, led by Prof. He, focuses on the relationship between economic development, environmental quality, and human health in China. This progress report includes summarizing a research brief for a working paper, exploring and commenting on potential research topics, data cleaning, and learning Stata skills. Each task serves a purpose: the research brief aims to spread our research results to the public, considering various potential research topics helps develop logical thinking, data cleaning helps improve Excel skills, and self-learning of Stata lays a foundation for analysis. The progress report is a summary of the work involved and personal reflections for the most recent 2 months.

Advisor: HE Guojun / SOSC
Student: LU Tianyi / GCS UROP Course: UROP1100, Summer 2016

Pollution and environmental problems are being seriously considered in this century. China is one of the largest emerging countries with a fast developing economic, but the country is suffering from consequences in the form of pollution. This UROP focuses on balancing economic development, environmental pollution, and human health. During this summer session, as a student research assistant, I was mainly responsible for three tasks: (1) Literature review and writing a research brief; after reviewing a previous research paper, I concluded and translated the original paper into a research brief used for public promotion on online platforms, such as WeChat. (2) Data cleaning assistance for the research project. (3) Self-learning Stata/R skills by using online resources. Through these tasks, I gained deeper understanding of this topic and developed some personal ideas regarding future research interests in related areas.

Advisor: HE Guojun / SOSC
Student: WANG Jiahui / MAEC UROP Course: UROP1100, Summer 2016

I participated in the project "Economic Development, Pollution, and Health in China," which entails several tasks. I wrote a Chinese research brief for the paper "Smog episodes, fine particulate pollution and mortality in China" and revised another paper brief "Growth, Pollution, and Life Expectancy: China from 1991–2002." From these two and some other papers, I determined potential research topics. In addition, I participated in data cleaning, such as county-level data cleaning, and identified changes in administrative divisions in certain years. To prepare for further research, I have self-learned basic skills of Stata and R-code, and I can now perform data cleaning.

Advisor: HE Guojun / SOSC
Student: WONG Alvin Y H / EVMT UROP Course: UROP1100, Summer 2016

In China, pollution is considered a serious problem, affecting people's health. According to the papers I read, particulate matter—one of the major air pollutants, mainly produced by combustion of coal, is associated with a number of cardiovascular and respiratory diseases, thus leading to a higher mortality rate for infants and elderly people. This problem is particularly serious in northern China because it has the policy of providing free or subsidized coal for warming. Water pollution can also increase infant mortality rate; furthermore, compared with heavy water pollution, moderate water pollution can have more serious consequences because it is rarely noticeable, leading to accidental polluted water consumption by people.

Media Cleavage on the Resource Curse in China

Advisor: HONG Jean (Ji Yeon) / SOSC
Student: LIN Yingyan / ECON UROP Course: UROP1100, Summer 2016

Linfen was a beautiful city famous for its flowers and agriculture until the late 1980s, when China's rapid industrialization led to the increasing demand for energy and steel. Coal mining, steel production, and other heavy industries have greatly damaged the city environmentally, distorting its economic structure, which is heavily dependent on natural resources; thus, these industries have risked the city's sustainability. Business drive and bureaucratic self-interests have pushed forward the clean-up of the city; however, the efforts and progress have not been long-term, indicating the difficulty of balancing environmental protection and economic growth. Here, the example of Ruhrgebiet—the largest industrial region in Germany and fifth largest in Europe—is used to discuss the potential development opportunities to devolve heavy polluting industries and achieve sustainable economic growth for Linfen in the future.

Understanding the Long-term Effect of State Repression: A Study of the 228 Incident

Advisor: HONG Jean (Ji Yeon) / SOSC
Student: LIN Ching Hsuan / ECOF UROP Course: UROP1100, Fall 2015

During this project, I assisted Prof. Hong on the topic "Understanding Long-term Effect of State Repression: A Study of the 228 Incident." The project was divided into three stages: (1) literature search for understanding the entire incident, (2) media search for understanding the attitudes of different parties in contemporary Taiwan, and (3) literature search regarding the current Taiwan political landscape. The 228 Incident is the issue that resulted from poor governance of the KMT government and cultural conflict between local Taiwanese and mainlanders. This incident has affected modern Taiwanese politics, particularly competition between the pan-blue and pan-green camps.

China/Africa Links Project

Advisor: SAUTMAN Barry Victor / SOSC
Student: KEVIN . / GCS UROP Course: UROP3100, Fall 2015
UROP4100, Spring 2016

In the final course of the UROP series related to China–Africa economic relations, I provide an epistemological review of reviews regarding the major work by the former New York Times journalist Howard W. French on these relations, titled "China's Second Continent: How A Million Migrants Are Building A New Empire in Africa." After reviewing more than 26 book reviews by people of various occupations, ranging from journalists to businesspeople and academics, I provide my evaluation regarding the methods the book has reviewed, and how the reviews define their perception and degree of knowledge in interaction between the Chinese and Africans. I demonstrated that journalists— particularly American journalists—tend to have an extremely positive view of Mr. French's book, whereas academics, and to some extent, businesspeople, have mixed-to-negative responses

regarding the work. Scholars on China–Africa relations express extremely negative evaluations, particularly on Mr. French's method for basing his arguments.

Advisor: SAUTMAN Barry Victor / SOSC
Student: ZHOU Weixuan / ECOF UROP Course: UROP2100, Fall 2015
UROP3100, Spring 2016
UROP4100, Summer 2016

Widespread pessimism of global economy and contingent instability triggered by the upgrading of China's industrial structure has brought uncertainty around China–Africa relations in recent years. However, the deepening of "One Belt, One Road" Initiative in Africa, with an emphasis on railway construction in Kenya and east Africa, and the rebounding of global oil price could reverse, or at least, moderate this pessimism. To examine the current status of China–Africa relations, we adopted a workforce localization rate of Chinese investment projects in Africa as an indicator. By using our expanding database, this essay will analyze Chinese localization in Africa in recent years and discuss recent trends.

The Hong Kong Anti-Mainlandization Movement

Advisor: SAUTMAN Barry Victor / SOSC
Student: LIN Yinghui / GCS UROP Course: UROP2100, Fall 2015

This report summarizes some of my thoughts regarding the antimainlandization movement in Hong Kong. This report comprises two parts: (1) Discussion about specific LegCo debates and some recent events—localist leaders and the two LegCo motions as well as soccer and Democracy Wall conflicts between mainland China and HK. (2) My thoughts regarding more general topics—freedom of information reception and indoctrination, commonplace of localists, and the unique identity as a Hong Kongese.

Advisor: SAUTMAN Barry Victor / SOSC
Student: WONG Yu Hin / OM UROP Course: UROP1100, Spring 2016

The antimainlandization movement has been a prominent theme in Hong Kong society and politics. Over time, this movement has developed from peaceful protests as in the 2014 Umbrella Movement to more extreme, proindependence forces. One such force is localism, a faction of the political movement in Hong Kong, focusing on the preservation of the city's autonomy and local culture. This project, the Hong Kong Antimainlandization Movement, involves regular research and analysis on localist movements, as well as carrying out statistical interviews with localist activists. This report analyzes three prominent events in the development of localism in Hong Kong: the Mongkok Riot, founding of the National Party, and release of the film Ten Years. It will include firsthand interview records with HKUST Progress and Alvin Yeung as well as an examination of the Sheung Shui Demonstration on May 1, 2016.

Advisor: SAUTMAN Barry Victor / SOSC
Student: JI Caixuan / GCS UROP Course: UROP1100, Spring 2016
UROP2100, Summer 2016
JIANG Wenhao / GCS UROP Course: UROP1100, Summer 2016
WU Wai Ming / SSCI UROP Course: UROP1000, Summer 2016

The antimainlandization movement has been a prominent theme in the Hong Kong society and politics. Over time, this movement has developed from peaceful protests as in the 2014 Umbrella Movement to more extreme, proindependence forces. One such force is localism, a faction of the political movement in Hong Kong, focusing on the preservation of the city's autonomy and local culture. This project, the Hong Kong Antimainlandization Movement, involves regular research and analysis on localist movements, as well as carrying out statistical interviews with localist activists. This report is a collection of interview notes from six prominent politicians in Hong Kong of proestablishment, pandemocratic, and localist camps: Felix Chung (Liberal Party), Ronny Tong (Path

of Democracy), Alan Leong (Civic Party), Emily Lau (Democratic Party), Alvin Cheng (Civic Passion), and Yau Wai-Ching (Youngspiration). The report highlights their viewpoints regarding the rise of localism in Hong Kong, the prospect of Hong Kong independence, as well as the positions of their respective parties.

Keywords—localism, Hong Kong, proestablishment, pandemocratic

Democratic Development in Asia and the World

Advisor: SING Ming / SOSC
Student: KWONG Ming Hong / GCS UROP Course: UROP1100, Fall 2015

The labor movement has been a critical social and democratic movement worldwide. In Hong Kong, the independent labor movement has been developing since the Hong Kong 1967 Left wing riots. However, its development has been difficult, with only few results. This paper aims to investigate the weakness of the labor movement and the causes of these weaknesses and provide some insight regarding its future development.

Advisor: SING Ming / SOSC
Student: KEVIN . / GCS UROP Course: UROP1100, Summer 2016

I use Lipset and Rokkan's cleavages model and Robertson's typology to explain the situation of political polarization in hybrid regimes, with a focus on Malaysia and Venezuela for crossregional, comparative purposes. This paper aims to demonstrate that exclusionary political practices, such as positive discrimination and populist policies, can induce unity among the countries' ruling regimes. Regarding political opposition, cleavage-based politics can also strengthen performance, but in a pattern more vulnerable to pressure from the regimes when they feel threatened by the rise of opposition strength. Increasing opposition strength does not automatically improve opposition unity in the long term. Opposition unity can also be undermined in the long term if the short-term primary focus is to only replace the existing regime.

Hong Kong Government and Politics

Advisor: SING Ming / SOSC
Student: KONG Yim Yu Stephanie / EVMT UROP Course: UROP1000, Summer 2016

The Umbrella Movement was a student-led 79-day rally in September 2014 and called for universal suffrage in the chief executive election without political screening for candidates. Several factors affect a person's decision in joining this movement—age group characteristics and exposure to prodemocratic media are two of them. The rise of prodemocratic media originates the trend of alternative media. Alternative media has been formed based on the fact that traditional media has long been following self-censorship and providing incomplete information. With the wider coverage of intent access and less regulated Internet platform, it has becoming increasingly popular among Internet users. Age group is another factor relevant in the study of the Umbrella Movement because most participants of the movement are youths. In this paper, the association of exposure to prodemocratic media and age group characteristics with Umbrella Movement participation is examined.

Internet Finance and Microcredit in China

Advisor: TSAI Kellee Sing / SOSC
Student: LI Siqi / SSCI UROP Course: UROP1000, Summer 2016

In general, peer-to-peer (P2P) Internet debt is a type of new debt model where individuals lend idle money to the needy. Compared with other debt methods, the P2P method has a high interest rate, small amounts loaned, convenience and low guarantee through the Internet. Starting from 2007, when the first P2P stage PAIPAIDAI was established, the P2P market has expanded rapidly and has become a major part of the Chinese Internet finance

market. However, with different development levels in different regions, P2P development has various characteristics and influences in different parts of China.

This essay first discusses the regional difference of P2P development in China and its impact on the inequality of different regions by comparing statistics and analyzing the factors potentially affecting the choices of investors and borrowers. We could subsequently discuss the reasons for the gap between the regions by analyzing the real case of Shanxi province.

Advisor: TSAI Kellee Sing / SOSC
Student: LI Yongzheng / GCS UROP Course: UROP1000, Summer 2016

The peer-to-peer (P2P) industry is booming in China. In this industry, Renrendai has a long history with high ratings and immense transaction volume. Through a brief study of the performance of Renrendai in the last year, I find that although the business trend is relatively stable, two anomalies are present in October 2015 and February 2016. October 2015 decreased as a result of institutional change—a platform transformation from P2P alone to wealth management. However, borrowers staying in Renrendai during October showed higher credibility. The February decrease exemplifies the cultural impact of the Spring Festival. Before the festival, the investment boomed in December.

Keywords—Renrendai, peer-to-peer

Emotion and Culture

Advisor: YIK Michelle / SOSC
Student: LAW Siu Yee / ACCT UROP Course: UROP2100, Fall 2015
UROP3100, Spring 2016

The emotional well-being research project has investigated the relationship between coping and affect and the effectiveness of coping strategies, to propose effective coping strategies for people encountering challenges. In Study 1 (N = 239) of the research project, HKUST students were surveyed on their negative thoughts and coping strategies to understand how they coped with challenges; consequently, four categories of coping strategies were identified, with no clear relationship between the coping strategies and affect type (activated, deactivated, or neutral). To further investigate whether the coping strategies used are effective, Study 2 (N = 275) asked participants to list out negative thoughts along with three coping strategies as well as to rate the effectiveness of each of the coping strategies. Cognitive engagement was the most effective for the unpleasant-activated affect, whereas emotion regulation was the most effective for both unpleasant-deactivated and unpleasant-neutral affect. As adolescents are a group encountering the most challenges, a third study is proposed to investigate the relationship between affect type and the effectiveness of the coping strategies, to propose a list of effective coping strategies to Hong Kong adolescents when they need support.

Advisor: YIK Michelle / SOSC
Student: CHAN Zelig / GBUS UROP Course: UROP1100, Summer 2016

Psychologists have long been interested in determining the relationship between culture and emotions. The debate on whether emotions are universal (Ekman & Keltner, 1997) and whether culture interacts with emotions (Lutz, 1988) has been studied extensively. In this thought paper, I aim to bring together some of my preliminary hypotheses concerning these two research areas. Under the vast topic “culture and emotions,” my focuses are self-conscious emotions and ideal affect. In the subsequent text, I briefly describe the two specific concepts, after which I introduce three hypotheses for each concept, resulting in a proposal with six hypotheses.

Advisor: YIK Michelle / SOSC
Student: LING Zhiheng / ENVS UROP Course: UROP1100, Summer 2016

My research interests focus on the relationship between Chinese stress-coping strategies and Chinese traditional philosophies, and the root cause attributed to the different responses directed toward achievement between East Asian and North American individuals. Based on my literature review, I hypothesize that culture plays is crucial role in the preceding two research areas.

China and the World

Advisor: ZWEIG David Stephen / SOSC
Co-advisor: KANG Siqin / SOSC
Student: CHEN Runhua / MAEC
UROP Course: UROP1100, Spring 2016

This article identifies the institutions and change in multiple aspects of the government-endorsed scholastic honor and sponsorship schemes in China, particularly the Changjiang Scholars Award Program, both from the perspectives of the authority and awardees. By collecting relevant sample data on personal curriculum vitae and academic publications, examining the consistency between conditions of laureates and implementation regulations of the program, and reviewing the performance of the program in recent years, this article concludes that the program begins to exhibit traits of ineffectiveness because of the flawed evaluation system and redundant bureaucracy in execution; thus, the positive influences of such programs are diluted.

Advisor: ZWEIG David Stephen / SOSC
Co-advisor: KANG Siqin / SOSC
Student: TAN Jingjing / GCS
UROP Course: UROP1100, Summer 2016

From the beginning of the 20th century, the National Talents Programs have been changing continually from sending students overseas to bringing them back to serve the country. Because the different social and political backgrounds, such as the multiple stages of economic development and the principles set by different leaders of political parties, the Chinese central government introduced distinctive National Talents Programs to fulfill the demand for the new era. The three National Talents Programs that this paper will discuss are the Hundreds Plan Program, the Cheung Kong Scholar, and the Thousand Talent Program. The quality of the returnees who were brought by these programs would be examined to determine the effectiveness of the programs. The reforms done by the returnees would also facilitate the programs to encourage more talented Chinese scholars to return.

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