UROP

Undergraduate Research Opportunities Program

Proceedings 2012-13

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 name, and then by alphabetical order of Advisor's surname.*

Summary of UROP Courses

Message from the **President**

The Undergraduate Research Opportunities Program (UROP) has been very successful since its launch in 2005, with a significant increase in the number of participating faculty members and students every year. Over 350 students joined the UROP in the 2012-13 academic year, with up to 140 faculty members offering almost 300 projects by shouldering additional responsibilities. Out of the many students who have joined UROP since its launch, around 28% have pursued postgraduate studies either in Hong Kong or in leading overseas universities after graduating.

These proceedings present overviews of the various research projects conducted by our undergraduate students under the guidance of their faculty supervisors. As a research-based university, HKUST spares no effort in equipping its students with both fundamental and applied knowledge. Through UROP, they gain hands-on experience of academic research using cutting-edge facilities that are typically available to postgraduates only. Given the encouraging achievements of our UROP participants, I am certain that this program will continue to thrive as a signature experience at HKUST.

Tony F Chan

President

HKUST

UROP Overview 2012-13

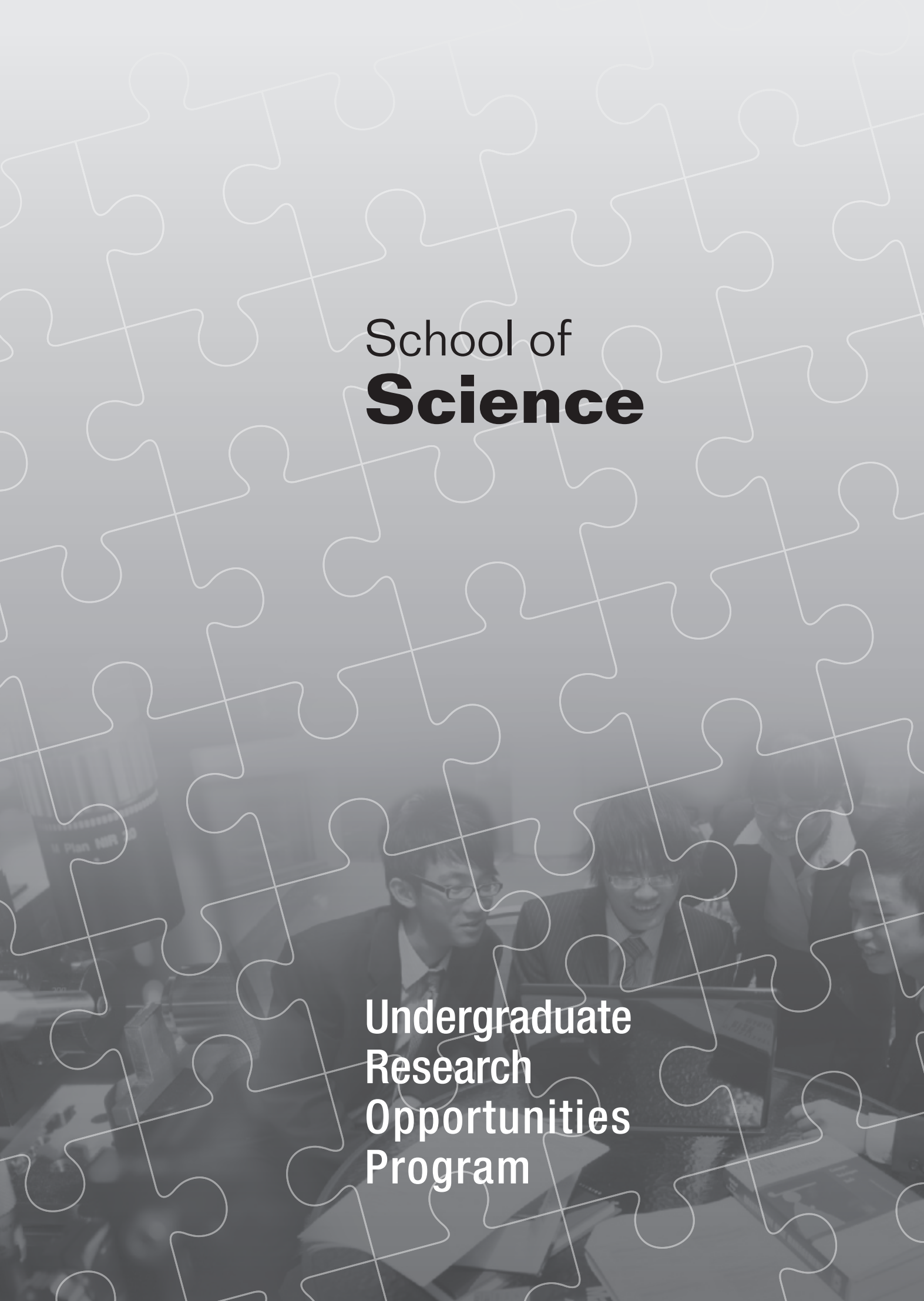
In the 2012-13 academic year, the Undergraduate Research Opportunities Program (UROP) continued to gain popularity among students. We were also glad to see a growing number of faculty members offering UROP projects and numerous students participating in the program to engage in academic research.

140 supervisors from different disciplines offered 294 projects this year, and their support and contributions resulted in a steady increase in student participation. During 2012-13, 353 students from 18 departments enrolled in the program, an almost 20% increase compared to the previous academic year. These students not only perpetuated the growth of the program, but also helped to broaden the research environment within the university community.

2013 Mr. Armin and Mrs. Lillian Kitchell Undergraduate Research Awards

23 students were nominated for the 2013 Mr. Armin and Mrs. Lillian Kitchell Undergraduate Research Awards by their UROP project advisors for their outstanding research performance. Among them, nine were shortlisted and participated in the final presentation to the UROP Advisory Board. After careful selection, 1 Winner, 2 First Runner-Ups and 3 Second Runner-Ups were chosen and the award presentation ceremony was held on April 23, 2013. All of the finalists were invited to present in a poster exhibition during the UROP Weeks from April 15-26, 2013 at HKUST.

School of
Science



Undergraduate Research Opportunities Program

Department of Chemistry

Modeling Protein-ligand Interactions Using Docking and Other Computational Tools

Advisor: *HUANG Xuhui / CHEM*
Student: *UNARTA Ilona Christy / CHEM*
(UROP Course: UROP1100, Spring 2013)

Tropomyosin-related kinases type B (TrkB) is a protein that is important in increasing the long-term survival, differentiation and function of newborn neurons in the adult hippocampus. In this project, the importance of TrkB activation motivates a search for novel small molecules capable of activating TrkB. Hence, the docking and similarity searching of known agonists were performed. The docking of known small molecule agonists produced unsatisfactory results due to a lack of suitable structures in the TrkB extracellular domain. The similarity searching of five known TrkB agonists generated 10 molecules with high similarity and low lipophilicity and toxicity. However, further investigations may be necessary to optimize these molecules by considering other properties such as the number of Hydrogen bond acceptors and donors.

Advisor: *HUANG Xuhui / CHEM*
Student: *WANG Ying / CHEM*
(UROP Courses: UROP1100, Fall 2012;
UROP1200, Summer 2013)

Experimental studies have revealed the importance of a conserved, mobile domain of RMA Polymerase, the Trigger Loop (TL), in substrate recognition and rapid catalysis. Yet the small size and flexibility of TL restricts further experimental studies to obtain the detailed dynamics of its conformational changes. In this project, we conduct theoretical studies employing computational tools to elucidate the dynamics of TL motion and address the question from a different perspective. Based on the results obtained from molecular dynamics simulations, we obtain an initial pathway connecting two states using the Climber morphing algorithm. Selected conformations from the initial path are then used as seeds to perform path dependent Metadynamics simulations. We then test several collective variables in an effort to describe the conformational changes.

Total Synthesis of Penicipyrone and Tenuipyrone Analogues for Biological Activity Evaluation

Advisor: *TONG Rongbiao / CHEM*
Student: *LIU Yuan / CHEM*
(UROP Course: UROP1100, Spring 2013)

Four different δ-hydroxyl-α,β-unsaturated ketones have been synthesized for cascade bicyclization reactions with four different 1,3-cyclodiketones, respectively, yielding analogues of the natural products tenuipyrone and penicipyrone. This cascade bicyclization reaction features intermolecular Michael addition and cyclo-ketalization. Generally, the cascade reaction produces high yields for five- and six-membered ring analogues ranging from 50% up to 90% yield, whereas the seven-membered ring analogues require a longer reaction time under harsher conditions to provide the cyclization products with relatively low yields.

Keywords – Cascade bicyclization; Intermolecular Michael addition; Cyclo-ketalization; Tenuipyrone; Penicipyrone

Chemical Characterization of Organic Compounds in Atmospheric Particles

Advisor: *YU Jianzhen / CHEM*
Student: *HO Chi Lung / CHEM*
(UROP Course: UROP1100, Fall 2012)

Air quality measurement is very important to society in the regulation of industrial pollution. PM2.5 is especially harmful to humans due to its small size, which can easily enter the human body. On March 8, 2012, the Environment Protection department began to announce PM2.5 data on its website, showing that people are growing increasingly concerned about the air quality. In this project, the literature related to the measurements of OC and EC, along with material from the Internet and the Environment Protection department, are summarized here as an introduction to this area of study.

Advisor: *YU Jianzhen / CHEM*
Student: *YIN Shuhui / CHEM*
(UROP Course: UROP1100, Fall 2012)

HUmic-Like substances (HULISs) constitute a significant fraction of atmospheric aerosols, which are important in climate change and human health but complicated to study. The development of a suitable method for isolating HULISs has been widely discussed. Solvent efficiency and inert properties are difficult to guarantee simultaneously. In this project, comparison of different elution agents in terms of the above two topics was carried out. Solvent efficiency is determined by varying the amount used for elution and the reaction possibility was reflected in the fluorescence spectra. Methanol shows a relatively high efficiency that provides a recovery of 80% to 90%, and a larger amount produces a higher recovery. Acetonitrile retains a recovery of about 50%, regardless of the amount used. The presence of ammonia in the eluting solvents results in a slightly different spectrum compared with pure acetonitrile or methanol, which show similar spectra. This suggests that changes be made in the spectroscopic properties of the original sample.

Division of Life Science

Characterization of Suppressor Mutations that Antagonize Body Size Control

Advisor: *CHOW King Lau / LIFS*
Student: *XIAO Wendi / BIOL*
(UROP Course: UROP1100, Fall 2012)

After conducting genetic screening last summer ("Genetic Identification of Negative Regulator of TGF-beta Signaling Pathway"), we identified several mutated *C. elegans* strains that display a suppressive effect on the *sma-6* loss-of-function mutation.

Successive experiments were conducted – including outcrossing, length measurement and complementation tests – to try to locate the involved genes on specific chromosomes. Outcrossing and mapping were done throughout the characterization process, accompanied by the screening of progenies in each generation. However, most of the experiments are still in progress and some did not yield informative results. Therefore, we cannot yet map the precise location of the genes to define a clear molecular identity of the genes involved.

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

Advisor: *CHOW King Lau / LIFS*
Student: *LI Dongshunyi / BICH*
(UROP Courses: UROP1100, Fall 2012;
UROP1200, Spring 2013)

The bone morphogenetic protein (BMP) signaling pathway plays an essential role in regulating morphogenesis and orchestrating our body's tissue architecture. Thanks to its conservation across distant species, it can be studied using *C. elegans* as a model. To characterize the two enhancer mutations of *sma-6* LOF mutation, in this project a series of experiments are conducted for the screening of the related mutations affecting BMP signaling. Last semester progress was made in documenting the characteristics of a few mutations, but subsequent experiments are needed to further characterize the mutations and follow up with the mapping exercise to define the molecular identities of the affected genes.

Screening for Genes Acting in the Hypodermis in a Time-specific Manner

Advisor: *CHOW King Lau / LIFS*
Student: *GU Bida / BIOL*
(UROP Course: UROP1000, Summer 2013)

In this project, Q system (Potter et al., 2010) – a transcription-based binary gene expression system recently introduced into *C. elegans* (Wei et al., 2012) – is reconstituted and will be applied to *C. elegans* using *lon-2* (Gumienny et al., 2007) gene promoter. The purpose is to investigate the role of this gene at different developmental stages using a time-specific gene activation approach. During the cloning process, various molecular manipulations are involved, and while we have made the desired plasmid construct, interesting phenomena and problems are encountered and discussed.

Study of DNA Replication in Human Cells

Advisor: *LIANG Chun / LIFS*
Student: *DAI Anna / BICH*
(UROP Course: UROP1000, Summer 2013)

Normal cell application in the lab is usually supported by DMEM with FBS. In this project, DMEM without FBS is used to starve HCT 116 cells (human colon carcinoma) and Hela cells (human cervix epitheloid carcinoma). After cell starvation, observing the FACs and western blot results individually and comparing the results between these two sets of samples revealed different effects.

Advisor: *LIANG Chun / LIFS*
Student: *LI Yuqiong / BIOL*
(UROP Courses: UROP1100, Fall 2012;
UROP1200, Summer 2013)

The conserved Cdc14 (cell division cycle 14) protein has been found to inactivate cyclin-dependent kinase (CDK), which is considered to play a vital role in regulating the progression of the mammalian cell cycle. Cdc14 was first identified and further studied in budding yeast, yet the role of this protein remains largely unclear in mammalian cells. Unlike a single Cdc14 protein in yeast cells there are two homologues, Cdc14A and Cdc14B, in mammalian cells. Cdc14B phosphatase is the protein of interest in this project. The cell cycle and protein expression were studied in both 293T and MCF. Using fluorescence-activated cell sorting (FACS) and western blotting to investigate the cell cycle and protein expression, respectively, our result supports that Cdc14B was capable of dephosphorylating MCM2 protein and keeping the proliferating cells in G1/S phase.

Keywords – Cdc14B phosphatase, Cell cycle analysis, Western Blotting, 293T, MCF

Advisor: *LIANG Chun / LIFS*
Student: *ZHU Ronghui / BICH*
(UROP Course: UROP1000, Summer 2013)

The yeast cell division cycle protein 14 (Cdc14p) has been shown to play an important role in cell cycle and DNA replication. hCdc14B is a human homologue of Cdc14p whose functions in the human cell cycle remain largely unknown. In this project, we show that several budding yeast pre-RC proteins can interact with hCdc14B. Among them, some are also substrates of Cdc14p, which indicates some function similarities between hCdc14B and Cdc14p. At the cell cycle level, the expression level of hCdc14B in HCT116 cells fluctuates in a certain pattern throughout the cell cycle. We propose a possible explanation to interpret this result and investigate the link between hCdc14B and cancer by studying the deviation of the hCdc14B expression level between tumor cells and normal cells.

Study of DNA replication-initiation proteins in budding yeast

Advisor: *LIANG Chun / LIFS*
Student: *ANDI PUTRA / BICH*
(UROP Course: UROP1000, Summer 2013)

Many criteria must be fulfilled before DNA replication, such as the presence and the right amount of proteins to begin the process. These proteins include the ORC complex, Cdc proteins and the MCM complex. The newly identified protein, Noc3p, shows its significance in the initiation of DNA replication in yeast cells (Zhang et al., 2002). This project shows how it serves as a link between ORC and other initiation proteins before DNA replication can take place. Its homolog in human cells, FAD24 protein or human Noc3 (hNoc3), has been studied extensively in our lab and it is believed that this protein homolog has a similar function in terms of the initiation of DNA replication.

Advisor: *LIANG Chun / LIFS*
Student: *KAN Chun Him / BICH*
(UROP Course: UROP1100, Summer 2013)

We examine the effects of common coenzymes NAD^+ and $NADP^+$, and those of common bivalent cations $MgCl_2$, $CaCl_2$ and $ZnCl_2$ on the ADH and ACDH activity of budding yeast (Strain W303-1A). ADH and ACDH work in a consecutive manner to oxidize ethanol to acetaldehyde and eventually to acetate. Either NADH or NADPH was produced in both steps. We determined the ACDH activity by adding acetaldehyde to the enzyme reaction medium and the combined activity of ADH and ACDH was discovered through ethanol addition. ADH activity was assumed to be far greater than that of ACDH, and to reach equilibrium in 10 minutes. Hence, the average activity of ADH can be approximated by computing the difference in the average activity between ethanol addition and acetaldehyde addition. After the experiment, we found that NAD+, MgCl2 and CaCl2 stimulated ADH while $NADP^+$, $MgCl_2$ and $CaCl_2$ stimulated ACDH. However, $ZnCl_2$ inhibited both ADH and ACDH.

Keywords - Saccharomyces cerevisiae; ethanol; acetaldehyde; aldehyde dehydrogenases

Advisor: *LIANG Chun / LIFS*
Student: *LI Dongshunyi / BICH*
(UROP Course: UROP1100, Summer 2013)

In the DNA replication of eukaryotic cells, the origin recognition complex (ORC) plays a significant role in initiation. The change in its activity has a profound effect on the initiation process. Nevertheless, the detailed process remains unknown. The experiment data in our lab indicate that ORC forms dimers during the G1 to M transition in the G1 phase. We further hypothesize that its dimerization depends on Noc3p. We design a chromatin binding assay and a coimmunoprecipitations assay (co-IP) to test our hypothesis. Before conducting the experiments, two preliminary tests are conducted: the depletion efficiency checking of *Noc3ts::Ura* and the expression checking of transformed mutant cells. The results suggest that the cell cycle of *Noc3ts::Ura* is likely to be disrupted at 37°C. The expression of plasmids, however, cannot be detected.

Advisor: *LIANG Chun / LIFS*
Student: *LIU Siyu / BIOL*
(UROP Courses: UROP1100, Spring 2013)

Molecular cloning is a set of experimental methods in molecular biology that are used to assemble recombinant DNA molecules and direct their replication within host organisms (Watson, 2007). During my work and study experiences in the biochemistry lab this semester, I gradually gained a rough understanding of the steps involved in and principles behind molecular cloning.

In this project, we focus on the study and identification of paired interactions between Rice black-streaked virus 2 segments in *E. coli*, which requires some molecular biology techniques to discover protein–protein interactions and protein–DNA interactions by testing for physical interactions (such as binding) between two proteins or a single protein and a DNA molecule, respectively. The protein used in this experiment is one strain of plant virus protein. By combining the target gene into the plasmid and then using the molecular cloning method to clone this gene, we can screen the clones with desired DNA inserts and biological properties to study their paired interactions. This semester, we are largely concerned with molecular cloning preparation.

Advisor: *LIANG Chun / LIFS*
Student: *MA Yujia / BIOL*
(UROP Course: UROP1000, Summer 2013)

A number of genes were previously found to be related to stomach cancer and DNA replication initiation functions. In this project, reverse transcription and real-time PCR were applied to evaluate the extent of interest genes' expression. For analysis, Relative Quantity (2^(-delta Ct)) was the main index. The higher the RQ value, the higher level of gene expression.

Keywords – Gene expression, DNA replication initiation, Reverse transcription, Real-time PCR

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

Advisor: *LIU Hongbin / LIFS*
Co-advisor: *LAU Wing Keung / LIFS*
Student: *LAO Hiu Yin / BICH*
(UROP Course: UROP1000, Summer 2013)
NG Cheuk Hei / BICH
(UROP Course: UROP1000, Summer 2013)
YEUNG So Shan / BICH
(*UROP Course: UROP1000, Summer 2013)*

In this project, we conducted a survey (June 2013) to monitor the water quality of the marine fish farming zones in Hong Kong. Water samples at different depths were collected from each of the marine fish farming zones once or twice a month, as designated by the Agriculture, Fisheries and Conservation Department (AFCD) in Hong Kong. Different hydrographic, water chemistry and biological parameters were measured during or after the sample collection. The level of suspended solids and chlorophyll *a* were covered as part of the indicator determining water quality.

Advisor: *LIU Hongbin / LIFS*
Co-advisor: *LAU Wing Keung / LIFS*
Student: *XIE Siwei / BICH*
(UROP Course: UROP1100, Spring 2013)

Water quality is essential for the maintenance of aquaculture in Hong Kong. A water quality survey is conducted regularly to monitor the marine condition in 26 marine fish zones and 5 offshore stations designated by the Agriculture, Fisheries and Conservation Department (AFCD). In this project, the amount of chlorophyll *a,* a widely used parameter that indicates the level of algal biomass, was measured and discussed. During the sample collection time, it was observed that there were phytoplankton blooms in Ap Chau, Sha Tau Kok (northeastern Hong Kong), Tiu Cham Wan and Tai Tau Chau (eastern Hong Kong). The reasons for these phytoplankton blooms were discussed.

An Exploration of Nuclear Dynamics in Cells and the Syncytia of Developing Zebrafish Embryos

Advisor: *MILLER Andrew L / LIFS*
Co-advisor: *HO Sarah E / LIFS*
Student: *XU Kaichun / BICH*
(UROP Courses: UROP1100, Fall 2012;
UROP1200, Spring 2013)

The intercellular calcium signal related to the distinguishable Ca^{2+} signaling period between ~17.5-19.5 hours post fertilization (hpf), which involves both nucleus and cytoplasmic Ca^{2+} waves, plays an important role in the first spontaneous contraction in the trunk muscle, which occurs at ~17 hpf during muscle development. Inositol-trisphosphate receptors (IP_3R) have been demonstrated to play a critical role in this Ca^{2+} signaling period. In this project, we illustrate the localization of three analogs of IP_3R in the slow muscle cells, including the nuclear location, their localization and their localization relationship with slow muscle cell myosin heavy chains.

Visualization of Macromolecule Dynamics within the Contractile Band during the Cytokinesis of Embryonic Cells

Advisor: *MILLER Andrew L / LIFS*
Co-advisor: *HO Sarah E / LIFS*
Student: *CHEN Yiyun / BICH*
(UROP Courses: UROP1100, Spring 2013;
UROP1200, Summer 2013)

The process of cytokinesis in a zebrafish embryo is regulated by a series of calcium transients regulated by a variety of calcium channels. The STIM1 protein and Ca^{2+} channel proteins Orai and TRPC are essential in the store-operated calcium entry (SOCE) pathway, which is responsible for replenishing the calcium store in endoplasmic reticulum (ER). 2-Aminoethoxydiphenyl borate (2-APB) is added to inhibit the Orai1 and TRPC channels and abolish SOCE function, resulting in incomplete cytokinesis. In this project, we show that SOCE may be important in regulating the Ca^{2+} signals during cytokinesis. The aequorin-Ca^{2+} imaging result indicates that the inhibition of SOCE lowers the amount of Ca^{2+} released and restrains the furrow-deepening signal from reaching the bottom of the blastodisc, causing incomplete cytokinesis.

Advisor: *MILLER Andrew L / LIFS*
Co-advisor: *HO Sarah E / LIFS*
Student: *YU Chung Yan / MBMS*
(UROP Course: UROP1100, Spring 2013)

Nicotinic acid adenine dinucleotide phosphate (NAADP) is a novel calcium-releasing second messenger, with its own novel receptor – the two-pore channels (TPCs). NAADP differs from its counterparts inositol 1,4,5-triphosphate (IP_3) and cyclic ADP-ribose (cADPR) by using acidic calcium stores rather than calcium from the endoplasmic reticulum. Calcium transients are known to traverse zebrafish (*Danio rerio*) eggs during activation, and such transients rely on internal calcium stores, presenting a possible link between NAADP and these calcium transients. However, NAADP is unable to trigger the elevation of the egg chorion, a key-step in egg activation, at its typical efficacious nano-molar concentrations.

Characterization of Novel Cell Cycle Regulators in Cancer Cells

Advisor: *POON Randy Y C / LIFS*
Student: *CAI Xi / BICH*
(UROP Course: UROP1100, Spring 2013)

Cell cycle control must be temporally and spatially precise to ensure the accurate production of two daughter cells, hence its importance. In this project, I identify the candidates of mitotic regulators by applying a down-regulation strategy to investigate the effect of genes on mitosis. The effects are then captured by the difference of mitotic length between the control and the experimental group. To better quantify the change in mitotic length, several anti-microtubule drugs are added to cells to extend the mitosis period.

In-depth Characterization of Novel Cell Cycle Regulators in Cancer Cells

Advisor: *POON Randy Y C / LIFS*
Student: *CAI Xi / BICH*
(UROP Course: UROP1100, Summer 2013)

Cell cycle control must be temporally and spatially precise to ensure the accurate production of two daughter cells, hence its importance. In this project, I identify the candidates of mitotic regulators by applying a down-regulation strategy to investigate the effect of genes on mitosis. The effects are then captured by the difference in mitotic length between the control and the experimental group. To better quantify the change in mitotic length, several anti-microtubule drugs are added to the cells to extend the mitosis period. Among the ten genes investigated, four were identified as candidates, which were then verified by different methods and with different anti-mitotic drugs.

Investigating Microtubule Regulation during Cell Proliferation, Migration and Morphogenesis

Advisor: *QI Robert Zhong / LIFS*
Student: *HAU Kwan Tang / BICH*
(UROP Course: UROP1100, Summer 2013)

Microtubules play an important role in organizing the cytoplasm of eukaryotic cells. Recently, scientists have suggested that the nucleation of new microtubules requires γ-tubulin, an essential protein that assembles into multi-subunit complexes such as human γ-tubulin ring complexes (γTuRCs). This project employs SDS-page and Western Blot testing to detect the microtubule-associated proteins (Nedd1) (C-Term 344-667WT,C-Term 344-667H615A,C-Term 344-667 H615F) expressed through molecular cloning as a way of investigating the association between tubulin and Nedd1 after changing one amino acid in the amino acid sequence. The mutations of 615 in the C-term 344-667 have no significant effect on the formation of Nedd1 because the intensity of the Western Blot bands of the two mutants are both similar to the wild type.

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

Advisor: *QIAN Peiyuan / LIFS*
Co-advisor: *XU Ying / LIFS*
Student: *HUANG Yuan / SSCI*
(UROP Course: UROP1000, Summer 2013)

Bacteria derived from organisms in the Red Sea have been proven to have significant value in biomedical and ecological applications. For example, natural products from marine bacteria show greater advantage over other antifouling agents based on tributyltin (TBT) and copper in terms of toxicity. In this project, various microbiological and chemical methods are applied to culture and purify a bacterium named *Slalinisphaera* and extract compounds from the fermentation product. By conducting antifouling and antibacterial bioassays in addition to determining their structures, we examine whether these compounds have novel bioactivity and probe the structure-activity relationship.

Keywords – Marine bacteria, Bioactive compounds, Antifouling coumpounds

Hair Testing in Drug Abusers

Advisor: *TSIM Karl W K / LIFS*
Student: *CHAN Chi Hin / SSCI*
(UROP Course: UROP1000, Summer 2013)

One way to reveal a history of synthetic cannabis consumption is to test hair using HPLC-MS/MS. In this project, this synthetic cannabinoid, JWH-018, is detected after 18 hours incubation with 4 hours sonication to extract from a sample immersed in 100% methanol. Drug separation, identification and quantification are achieved by HPLC-MS/MS. The linear regression analysis is calibrated by internal standard THC-OH-D3 with R^2 equaling 0.998. The limit of detection (LOD) and limit of quantification (LOQ) for JWH-018 are both 0.05 pg/μL. The calibration curve ranges from LOQ to 500 pg/μL. The validation parameter, including linearity, sensitivity, precision and accuracy, are evaluated.

Keywords – JWH-018, HPLC-MS/MS, synthetic cannabis, validation

Advisor: *TSIM Karl W K / LIFS*
Student: *LAU Chun Yin Oliver / BICH*
(UROP Course: UROP1100, Spring 2013)

Methaqualone, a depressant that can affect the central nervous system, is sometimes abused with the abuser subsequently developing addiction, anxiety and depression. In this project, a quantification method was developed using liquid chromatography/tandem mass spectrometry (HPLC/MS-MS) for the determination of methaqualone in human hair. Hair samples were decontaminated, dried and cut. The hair was extracted together with Diazepam-D5 (internal standard) and the analytes were chromatographed and detected by (HPLC/MS-MS) using electrospray ionization. The linearity, repeatability, extraction efficiency, process efficiency and matrix effect were determined to be in accordance with regulations for the validation of the method.

Advisor: *TSIM Karl W K / LIFS*
Student: *LEUNG Wing Yan Yonna / BIOL*
(UROP Course: UROP1100, Fall 2012)

In this project, the first stage for developing a method of detecting 1-benzylpiperzaine (BZP) and 3-trifluoroethylphenylpiperazine (TFMPP) in hair was launched. The precursor ions for BZP, TFMPP and their respective internal standards, BZP-D7 and TFMPP-D4, were determined, respectively. The MS condition was optimized for the detection of BZP and TFMPP. BZP and TFMPP were extracted with 25% methanol, 25% acetonitrile and 50% ammonium formate. The linear regression analysis was calibrated by deuterated internal standards with an R^2 of 0.9986 for BZP and 0.9966 for TFMPP. The limit of detection (LOD) and the limit of quantification (LOQ) for BZP and TFMPP were both 10 pg/uL. Both standard curves were linear from the value of LOQ up to 1000 pg/uL. The matrix effect and extraction efficiency were also determined.

Advisor: *TSIM Karl W K / LIFS*
Student: *LO Wing Hei / SSCI*
(UROP Course: UROP1000, Summer 2013)

In this project, a prevalent hair testing method for general psychoactive drugs using high-performance liquid chromatography coupled with tandem mass spectrometry (HPLC-MS/MS) underwent the optimization of its extraction method and the condition of its machines to develop a detection system with suitable operating conditions for detecting a synthetic cannabinoid, HU-210, in human hair. The drugs deposited were extracted by incubation, followed by sonication. With the drug identification and quantification by tandem mass spectrometer, the chromatographic separation was achieved in 12 minutes. An internal standard was used in the calibration of linear regression analysis with a correlation coefficient (R^2) of 0.994. The limit of detection (LOD) and the limit of quantification (LOQ) for HU-210 were both 5 pg/μL of the hair extract. The linear range was from the value of LOQ to 500 pg/μL of the hair extract. Validation parameters such as linearity, LOD and LOQ, precision and accuracy were determined. In conclusion, an effective detection method was investigated with the use of HPLC-MS/MS to achieve a more precise result.

Keywords **–** HU-210 Drug abuse hair analysis LCMS· Method development synthetic cannabinoids THC

Advisor: *TSIM Karl W K / LIFS*
Student: *ZHANG Minglu / BIOL*
(UROP Course: UROP1100, Fall 2012)

In this project, a quantitative HPLC-Chip-MS/MS method was developed for simultaneously measuring the presence of nine commonly abused drugs in the Benzodiazepine family. Method validation was applied to determine the method's linearity and sensitivity. Linearity is the relationship between the concentration of the analyte in the sample and the corresponding response. Sensitivity is validated by finding the limit of detection (LOD) and limit of quantification (LOQ) of the analyte. As a result, the linear regression analysis was calibrated by deuterated internal standards with an R^2 of 0.99. The limit of detection (LOD) and the limit of quantification (LOQ) were 12.5 pg/mg and 125 pg/mg, respectively.

G Proteins and their Regulators in Cancer Biology

Advisor: *WONG Yung Hou / LIFS*
Student: *CHEN Yiyun / BICH*
(UROP Course: UROP1100, Fall 2012)

The fragile histidine triad (FHIT) gene is a tumor suppressor gene located at region 3p14.2 on the short arm of human chromosome 3, encompassing the most active common fragile site FRA3B locus. The Fhit protein can be phosphorylated by tyrosine-protein kinase Src, which is involved in the G protein signaling pathway. Among different Gα subunits in the G protein family, activated $G\alpha_q$ shows a high affinity for Fhit binding and increases its expression, and thus may enhance its tumor suppressing activity. In this project, Fhit degradation was not involved in the active $G\alpha_q$-induced FHIT expression. In HEK293 cells stably expressing Fhit, $G\alpha_q$ activation inhibited cell growth. We also found that, in the presence of Fhit, activating $G\alpha_q$ increased cell aggregation in lung cancer cell line H1299 and kidney epithelial cell HEK293.

Advisor: *WONG Yung Hou / LIFS*
Student: *CHENG Ka Fai / BICH*
(UROP Course: UROP1100, Fall 2012)

RGS proteins are regarded as regulators of G protein signaling that function as GTPase-activating proteins, which catalyst the hydrolysis of the GTP of the activated Gα subunit to deactivate the G protein-coupled receptors' (GPCRs') mediated signal cascade. However, studies have shown that RGS proteins have other functions besides their role in G protein signaling, even playing multiple roles in the psychological pathways of cells. RGS20 is a member of the RGS RZ/A subfamily shown to enhance the cell aggregation in NIH3T3 and the cell survival ability in MDA-MB-231 when RGS 20 are overexpressed in the cell. This enhanced cell aggregation ability implies that RGS19 may play a role in cancer metastasis. This project attempts to discover the regulatory rolls of these RGS proteins in various stages of tumor development.

Advisor: *WONG Yung Hou / LIFS*
Student: *LEUNG Yuen Mei / BICH*
(UROP Course: UROP1100, Spring 2013)

The roles of the regulators of G protein signaling (RGS proteins) in human cancer cells are of emerging interest, as they have been implicated in cell proliferation and metastasis in several mammalian cell lines. Thus, in this project, the effects of transiently and stably transfect RGS19 and RGS20 in human breast adenocarcinoma cells (MDA-MB-231 cells) are characterized. In MTT assays, the RGS19/MDA stable cell line has demonstrated a higher proliferation rate than the RGS20/MDA cell line and the parental MDA cells. In MDA cells stably expressing RGS19 and RGS20, there is an upregulation in NM23-H1 that is one of the isoforms of tumor metastasis suppressor NM23. Elevated levels of NM23-H1 represent the possibility of metastasis in cancer cells due to the presence of RGS19 and RGS20 in the stable cell lines. In addition, there is a downregulation in the expression of ERK after serum starvation in transiently expressed RGS19 and RGS20. Akt signaling is also suppressed after serum starvation.

Advisor: *WONG Yung Hou / LIFS*
Student: *LIU Jijun / BICH*
(UROP Course: UROP1100, Spring 2013)

RGS19 is a regulator protein of G-protein signaling and its overexpression enhances cell proliferation in several types of mammalian cells. This project shows that the overexpression of RGS19 can promote the cell growth of MDA human breast cancer cells. The enhanced cell growth may be mediated through the regulation of the AKT pathway and is independent from the activation of the ERK signaling pathway. Moreover, the stable expression of RGS19 upregulates the expression of metastasis suppressor Nm23 in MDA cells. The upregulation of Nm23, however, was not observed in the transiently transfected MDA/RGS19 cells. Thus, these results indicate that the stable expression of RGS19 may be correlated with cancer cell metastasis.

Advisor: *WONG Yung Hou / LIFS*
Student: *TANG Lok Kan / BICH*
(UROP Course: UROP1100, Summer 2013)
TSANG Oi Ling / BICH
(UROP Course: UROP1100, Summer 2013)
YU Ho Yan / BIOL
(UROP Course: UROP1100, Summer 2013)

G protein-coupled receptors are essential transmembrance receptors for converting extracellular stimuli into intracellular signals. They are also critical in stimulating second messenger generating systems to further regulate some biological functions. In this project, we examined the signaling integration of G protein-coupled receptors by stimulating receptors with different coupling specificities using HeLa human cervix epithelial cells. We found that the simultaneous stimulation of G_i- and G_q-coupled receptors led to synergistic ERK activation and iL-8 production, but signaling from G_s seemed to inhibit the synergism from G_i- and G_q-coupled receptors' signaling. The simultaneous stimulation of G_i- and G_g-coupled receptors was also found to have a synergistic relation in terms of intracellular Ca^{2+} elevation, whereas signaling from G_s-coupled receptors intensified its corresponding activity.

Advisor: WONG Yung Hou / LIFS
Student: YU Xiaoying / BICH
(*UROP Courses: UROP1100, Fall 2012;*
UROP1200, Spring 2013)

Previous studies have shown that a diadenosine triphosphate (Ap_3A) hydrolase FHIT may act as a tumor suppressor. Heterotrimeric guanine nucleotide binding proteins (G proteins) play an important role in signaling pathways. A process called Epithelial–mesenchymal transition (EMT), in which epithelial cells lose their cell polarity and cell-cell adhesion, gain migratory and invasive properties and at last become mesenchymal cells, may influence invasion, the metastasis of carcinoma cells and the generation of life-threatening manifestations of cancer progression. In this project, the effects of FHIT and $G\alpha_{16}$ on the localization of the adhesion proteins in H1299 stable cells and HEK293 stable cells, and the effects of FHIT and $G\alpha_q$ on the localization of the adhesion proteins in 293 stable cells were studied.

Molecular Study of Genes in Brain Functions and Diseases

Advisor: *XIA Jun / LIFS*
Student: *LIANG Siqi / BICH*
(UROP Course: UROP1200, Fall 2012)

AMPA receptor synaptic trafficking is critical to the molecular mechanism of synaptic plasticity, and two proteins – PICK1 (a protein that interacts with C kinase 1) and ICA69 (islet cell autoantigen 69 kDa) – have been found to be involved. The BAR domain complex between PICK1 and ICA69 regulates intracellular AMPAR trafficking. To prepare for a GST pull-down assay to determine the interacting domains, GST constructs were obtained and induced to express in *E.coli* BL21 by IPTG. An optimum concentration of IPTG was tested and applied to purify the corresponding GST-tagged proteins. A vector, pEGFP-C3, was also modified and linked with a neuroselective promoter to further study the proteins in neurons.

Advisor: *XIA Jun / LIFS*
Student: *WANG Yicheng / BICH*
(UROP Courses: UROP1100, Spring 2013;
UROP1200, Summer 2013)

The purification of protein, which can then be used as a specific antigen in immunoprecipitation (IP) to purify antibodies, is an important procedure for studying the interested protein. In this project, we use affinity chromatography to purify WW and C-Terminal domains (protein domains of conserved composition that exist in many different kinds of proteins). These purified protein domains are then used to generate antibodies in lab rabbits and eventually purify these antibodies by IP.

Human Complex Disease Genomics and Bioinformatics

Advisor: *XUE Hong / LIFS*
Co-advisor: *LIANG Chun / LIFS*
Student: *PANG Chau Yung / BIOL*
(UROP Course: UROP1100, Fall 2012)

Tryptophan is an essential amino acid for bacteria growth. Under restrictions to grow in different tryptophan analog mediums, the mutants of *Bacillus subtilis* can acquire and survive under altered forms of tryptophan, such as 4-fluorotryptophan (4FT), 5-fluorotryptophan (5FT) and 6-fluorotryptophan (6FT). There are 271 essential genes out of 4100 genes indispensable for growth, in which 190 of the genes involved in these tryptophan analogs use mutations and most of them are caused by single nucleotide mutations. In this project, they are examined by purifying the genomic DNA of mutant strains of bacteria, amplifying the target regions of DNA using PCR and comparing the mutant nucleotide between the mutant strains and the wild type strain using DNA sequencing.

Advisor: *XUE Hong / LIFS*
Co-advisor: *LIANG Chun / LIFS*
Student: *SUN Xing / BICH*
(UROP Course: UROP1200, Fall 2012)

Studies of disease-linked single nucleotide polymorphisms (SNPs) have been yielding valuable knowledge on various diseases. In this project, 18 SNPs in the GABRB2 gene were genotyped on samples from schizophrenia patients by direct sequencing. The admission of novel amino acid analogues into the genetically encoded amino acid ensemble was also studied. *B. subtilis* Trp-auxotroph QB928 was previously mutated to enable the encoding of 4-fluoroTryptophan (4FT), 5-fluoroTryptophan (5FT) and 6-fluoroTryptophan (6FT) for indefinite growth. To further investigate the mutations at the gene level, these mutants are cultivated from the stock and their genomes are extracted for sequencing. The genomic DNA of QB928 strain LC33 is then sent in for sequencing.

Receptor-based Drug Development from Chinese Herbal Medicine

Advisor: *XUE Hong / LIFS*
Student: *QI Yi / BICH*
(UROP Course: UROP1100, Spring 2013)

In previous studies, Calmlin, a drug formula developed from Chinese herbal medicine, and dl-THP, an extractant from one of the four components in Calmlin, were shown to have anti-anxiety properties without sedation and other side effects. In this project, the two drugs' other potential functions were tested. Dl-THP was tested via a tail suspension test of mice to investigate its anti-depressant properties. Calmlin was tested for its effect on the D-galactose-induced aging model. An MDA test was done on the brain homogenates of mice that had taken D-galactose and Calmlin to examine dl-THP's relief on MDA level decrease induced by D-galactose. The results showed that dl-THP had an anti-depressant effect on mice and the relieving effect of Calmlin on spatial memory loss and brain MDA level decrease induced by D-galactose was proven by Y-maze spontaneous alternation and MDA tests. The test on L-THP showed no observable toxic effect on mice in one week, despite reports that dl-THP caused mice to swell.

Advisor: *XUE Hong / LIFS*
Student: *SHING Wai Ho / BICH*
(UROP Course: UROP1100, Summer 2013)

Chinese herbal medicine has been used by Chinese for more than 5000 years to cure diseases. There may be some useful substances present in the herbs that affect our bodies' functions. In this project, we focused on *Scutellaria baicalensis* (huang qin), which contains wogonin, a flavonoid-like compound with a strong anxiolytic effect. Recent studies have also found that wogonin may have anti-tumor and anti-inflammatory characteristics. An economical method for extracting this substance with high yield and purity will be beneficial. Various methods were adopted to isolate wogonin for the *Scutellaria baicalensis* extract. The yield and purity of wogonin were monitored by performing HPLC.

Department of Mathematics

Lunar Study Based on Data Obtained by the Chang'E Spacecraft

Advisor: *CHAN Kwing Lam / MATH*
Co-advisor: *CHENG Siu Wing / CSE*
Student: *CHUNG Chak Pong / MATH-GM*
(UROP Course: UROP1100, Fall 2012)
QIU Shao / MAEC
(UROP Course: UROP1100, Fall 2012)

The dataset we use in this project is based on previous work, specifically the lunar craters Einstein and Tsiokovsky with binary classification. It describes what we have tried, the useful tools we have developed and directions for future work. Our work this semester can be divided into three phases. Phase one we study the mechanisms of the support vector machine and related mathematical background. Phase two we study the typical use and skill of the SVM library (a programming library called LIBSVM). With our understanding of SVM in this lunar study, our focus shifts to thinking about how to define the characteristics of lunar craters with mathematical expression so that they can be transformed into useful data input to be tested by SVM. Preliminary algorithms are proposed at the end, directing future work.

Advisor: *CHAN Kwing Lam / MATH*
Co-advisor: *CHENG Siu Wing / CSE*
Student: *CHUNG Chak Pong / MATH-GM*
(UROP Course: UROP1200, Spring 2013)

Craters are typical geographical surface features of the Moon. Extensive studies of the Moon's surface keep drawing attention with increasingly accurate information from lunar space missions. Many papers have been published that detect lunar craters with images, e.g. the Segmentation-based approach by Blue and Stepinski (2007) discusses the pros and cons of the Hough Transform and Edge-based methods. Morpholoogical construction using an ellipse can be found in the work of Kim el al (2005). and feature extraction combined with the support vector machine (SVM) approach is discussed by Vinogradova et al (2002). However, the crater detection problem is not completely sloved, as every approach has its limitations. For example, image-based techniques are limited to certain sunlight conditions and angles from which the images are taken because they produce different gray-scale images in the same place. The SVM approach is not easy because the feature extraction from which SVM can learn the pattern of the crater is subjective and hard to conduct. In view of these difficulties, a method that is less restrictive on noise in the image and assumptions of the craters' geographical features is needed for wider application.

In this project, our target is to find the locations of craters and related information about their landforms using the digital elevation model (DEM) data and gray scale images provided by the Chinese Chang'E-1 and Chang'E-2 spacecraft. We have tested three different methods to search for craters with DEM data and the gray scale crater images.

Space Orbit Design

Advisor: *CHAN Kwing Lam / MATH*
Co-advisor: *WONG Michael K Y / PHYS*
Student: *CHEUNG Yat Fei / PHYS*
(UROP Course: UROP1000, Summer 2013)
NG Tsz Yu / PHYS
(UROP Course: UROP1000, Summer 2013)
NGAI Cheuk Yu / APHYS-ST
(UROP Course: UROP1000, Summer 2013)

Based on the mission to Uranus proposed by the Department of Mathematics and the Centre for Space Science Research, the further evaluation and estimation of that mission is the focus of this project. To ensure that the spacecraft completes the different missions – such as measurements of atmospheric composition, retrograde winds and the off-centered magnetic axis of Uranus – we concentrate on communication and the spacecraft's power and propulsion system. Instead of the building systems, the scientific instruments and spacecraft components under the constraints of mass, power and volume are another focus of this project.

Advisor: *CHAN Kwing Lam / MATH*
Co-advisor: *WONG Michael K Y / PHYS*
Student: *CHU Kin Chiu / PHYS-PM*
(UROP Course: UROP1100, Fall 2012)
HEIMONEN Hermanni Juuso Elias / PHYS-PM
(UROP Course: UROP1100, Fall 2012)
LEUNG Kai Yin / PHYS-PM
(UROP Course: UROP1100, Fall 2012)

This project began with an analysis of the different aspects of the mission, such as the performance index and the mass penalty at the Jupiter fly-bys. The first task was to devise a method for determining which face of the "football" the spacecraft is visiting at each fly-by to determine the performance index for potential trajectories. This is complicated by the fact that some of the faces are hexagonal while other are pentagonal. Three solutions to this problem have been found based on different methodologies. Although the algorithm to solve the face location problem can be easily applied to the whole truncated icosahedron thanks to its high symmetry, the bugs that result from partial misallocation may occur if the cache data are not correct. The debugging process can be difficult and time consuming if the problem is complicated and the cache data are huge. Therefore, instead of directly checking every part of the code and cache data, the bugs are located with testing data, which are randomly generated, and a 3D graph with proper markings. The random generator for the test data eliminates the chance of neglecting bugs due to systematic selection by humans. Proper marking of the data not only allows problems to be located, but also indicates the reason for them.

Advisor: *CHAN Kwing Lam / MATH*
Co-advisor: *WONG Michael K Y / PHYS*
Student: *HEIMONEN Hermanni Juuso Elias / PHYS-PM*
(UROP Course: UROP1200, Spring 2013)

We study the behavior of the solutions to low-thrust two-point boundary value problems with different boundary conditions. The limits of the possible launch and arrival velocities are first studied in a simplified two-dimensional transfer analogous to the Lambert problem from Earth to Mars, using large grid searches over possible velocities with a local optimizer. The solutions are then generalized to a three-dimensional problem and the low-thrust solutions are compared with ballistic solutions to the Lambert problem. In the low-thrust boundary value problem we find that the launch velocities form an elliptic region around the ballistic solution, in which the size of the region depends linearly on the thrust of the spacecraft. This also implies that variation in the launch velocity is not uniform in all directions. Finally, the same method is applied to a hyperbolic fly-by at Callisto that could be used to design capture trajectories at Jupiter. This indicates that the method is applicable to a range of mission analysis situations. The results help us understand the nature of the boundary value problems, so that we can potentially improve the techniques in designing low-thrust trajectories.

Wind Bands on the Giant Planets

Advisor: *CHAN Kwing Lam / MATH*
Student: *LI Cheung Shun / PHYS*
(UROP Course: UROP1000, Summer 2013)
YANG Hannan / PHYS
(UROP Course: UROP1000, Summer 2013)
YUEN Wai Yin / PHYS-PP
(UROP Course: UROP1000, Summer 2013)

The four planets in the solar system beyond Mars are classified as ‘giant’ planets: Jupiter, Saturn, Neptune and Uranus. They have many similarities and a few differences. First, they are all massive and emit more energy than they get from the Sun. They all have thick gaseous atmospheres. Most importantly, they all have very strong east-west winds and each has a large, long-lived spot that, together, are the focus of this project. With these similarities, one would expect these four planets to possess similar properties. However, the inner two (Jupiter and Saturn) have equatorial winds that blow in the same direction as planetary rotation while the outer two (Neptune and Uranus) have winds that blow in the opposite direction of planetary rotation. In this project, we aim to find out the cause of these differences and similarities using computer programming to analyze numerical data.

Statistical Analysis in Portfolio Construction

Advisor: *CHEN Kani / MATH*
Student: *HU Kun / ECOF*
(UROP Courses: UROP1100, Fall 2012;
UROP1200, Spring 2013)
WANG Qinyu / MATH-PMA
(UROP Courses: UROP1100, Fall 2012;
UROP1200, Spring 2013)

We empirically analyze the use of the penalized least squares method in vast portfolio construction. In particular, the performance of ordinary least squares, ridge (L-2 norm penalty) and LAR-LASSO (L-1 norm penalty) with different gross exposure constraints, the vanilla Markowitz method, the 1/N naïve strategy and no-short sell portfolios are compared. The results indicate that the LASSO method does not significantly dominate the no-short sell portfolios, but produces sparse solutions and offers a theoretical basis for the constraint on gross exposure level.

Keywords— portfolio theory; least square; LASSO; gross exposure constraint; short-sale constraint

Scientific Computing and Flow Visualization

Advisor: *FUNG Jimmy C H / MATH*
Student: *LAI Yiu Ting / MATH-AM*
(UROP Course: UROP1000, Summer 2013)
WONG Tsz Fung / MATH-AM
(UROP Course: UROP1000, Summer 2013)

In this project, we visualize planetary boundary flows by means of numerically tracking continuously released inert and weightless particles that advect across the lowest few kilometers of the atmosphere. This is a derivative development based on a system of Fortran 77 codes with the demonstrable skills to track tens of thousands of particles traversing a numerical wind field generated by the mesoscale meteorological model MM5. The current phase of the project entails:

code refactoring, which includes porting to the MATLAB development environment;
adaptation to the WRF mesoscale meteorological model results;
memory management improvements intended to enable tracking of millions of particles; and
development of novel visualization techniques that may draw upon massively parallel computing and rendering hardware such as GPU engines.

This interim report encapsulates the challenges and accomplishments pertaining to code refactoring and adaptation to the WRF mesoscale meteorological model results.

Asymptotic Methods for High Frequency Wave Phenomena

Advisor: *LEUNG Shing Yu / MATH*
Student: *AU Ching Yung / MATH-AM*
(UROP Course: UROP1100, Fall 2012)

We consider the Schrödinger equation for a particle with unit mass

$$\left(\mathrm{i}\hbar\frac{\partial}{\partial \mathrm{t}} - \mathrm{H}\right)\psi \equiv \mathrm{i}\hbar\psi_{\mathrm{t}} - \mathrm{V}(\mathrm{x})\psi + \frac{\hbar^2}{2}\Delta\psi = 0, \mathrm{x} \in \mathrm{R}^{\mathrm{d}},\ \mathrm{t} > 0,$$

for some initial condition. The goal of the project is to develop a numerical method to efficiently evaluate the integral

$$\psi(y; t+\varepsilon) = \int \frac{\psi(x;t)}{\sqrt{2\pi i\hbar\varepsilon}} e^{\frac{i(x-y)^2}{2\hbar\varepsilon}} e^{\frac{i\varepsilon V(x)}{\hbar}} dx.$$

Because the above integral equation does not have an analytical solution, we can only solve it numerically. The first part of the project is to use the simplest method to evaluate the integral, i.e. trapezoidal rule. However, this method is not practically useful due to low efficiency. Therefore, we need to seek a faster method. Due to the special property of the integrand, we propose a numerical algorithm in MATLAB based on the Fast Fourier Transform (FFT).

Advisor: *LEUNG Shing Yu / MATH*
Student: *LAI Tsun Tak / MATH-PM*
(UROP Course: UROP1100, Summer 2013)
WONG Lung Fai / MATH
(UROP Course: UROP1100, Summer 2013)

The objectives of this project are to show the methods developed and the corresponding codes, and discuss how to promote the ideas to a higher dimension. We examine methods of finding the normal vectors of finite points of a curve to approximate the wavefront. The waves tested are given to be smooth in two-dimensional space. The details of generalizing the method to three-dimensional space are also discussed.

Advisor: *LEUNG Shing Yu / MATH*
Student: *LAI Yiu Ting / MATH*
(UROP Course: UROP1100, Fall 2012)
YAM Yau Chuen / MATH-MP
(UROP Course: UROP1100, Fall 2012)

We investigate a new method for simulating the propagation of high frequency waves by computer. Relying on calculating the *r*-offset of the propagated wave, existing plotting methods have two main limitations. After the wave propagates for some time, the curve disperses. There are also some sharp points on the curve where the direction of propagation cannot be determined. We try to solve these problems using a new method – transforming the curve on the plane to a three-dimensional curve and letting it propagate in space while projecting the propagated "tube" on the plane. Then, the required propagated wave is the boundaries of the shadow. The advantages and limitations of this method are discussed.

Advisor: *LEUNG Shing Yu / MATH*
Student: *WANG Tianyu / MATH-AM*
(UROP Course: UROP1100, Spring 2013)
WU Yueshen / CHEM
(UROP Course: UROP1100, Spring 2013)

We develop numerical approaches to resolve the propagation of a Gaussian wave packet and to model diffraction patterns in inhomogeneous media. By using the newly developed lower-order Taylor-expansion based convolution methods in the position space, we model in sequence several different scenarios in one- and two-dimensional cases to obtain the optimal conditions for simulation. We then simulate the diffraction pattern with square-like potentials in a two-dimensional case.

Efficient Numerical Methods for Dynamic Interface

Advisor: *LEUNG Shing Yu / MATH*
Student: *XIE Zhaoming / CPEG*
(UROP Course: UROP1100, Summer 2013)

The goal of this project is to find out how the level set method can be used to compute the line integral of a circle (namely the arc length) inside a square bounded by [0,1] x [0,1] numerically, and how good the approximation can be.

Visualization of Dynamical Systems using Lyapunov Exponent

Advisor: *LEUNG Shing Yu / MATH*
Student: *HE Xingyu / SSCI*
(UROP Course: UROP1100, Summer 2013)
YANG Kaiqi / SSCI
(UROP Course: UROP1100, Summer 2013)

We study the pendulum motion with driving force and damping coherent. We assume the initial angle is small enough to make the approximation valid. After the approximation, this differential equation becomes a linear system with an analytic solution. If we do not use the approximation, the system is no longer linear and has no analytic solution. We obtain the trajectories and the FTLE by using a fixed step-length, fourth-order, Runge-Kutta integration scheme via MATLAB.

Financial Engineering Problems in Trading and Investment

Advisor: *PENG Xianhua / MATH*
Student: *DAI Chaoxing / MAEC*
(UROP Course: UROP1100, Fall 2012)
WANG Mengxue / MAEC
(UROP Course: UROP1100, Fall 2012)
WANG Shuanglong / PHYS-PM
(UROP Course: UROP1100, Fall 2012)

We review the CST model on stochastic and its assumptions, parameter estimations and mathematical structures are discussed. Two programs aimed at parameter estimation and hypothesis testing are constructed and their detailed inter and intra structures are presented. We also display the sample output of the two programs and the results are discussed, respectively, along with our ideas about future extensions.

Department of Physics

Quantum Optics and Super-Resolution Microscopy

Advisor: *DU Shengwang / PHYS*
Student: *SHU Chi / SSCI*
(UROP Course: UROP1000, Summer 2013)

Single photons play an important role in modern physics, with their quantum properties allowing them to behave quite differently from classical electromagnetic waves. A single photon can be easily obtained by detecting one photon in an entangled photon pair. Previous work has shown that entangled photons can be generated in a cold atomic assembly, but it is hard to achieve a high-quality entangled photon pair from a hot atomic vapor cell. Our work mainly involves obtaining a good quality entangled photon pair from a four-wave mixing process in an Rb87 cell.

Characterizing Single-molecule Electronic Properties using Low-temperature Scanning Tunneling Microscopy

Advisor: *LIN Nian / PHYS*
Student: *CHEN Shen / APHYS-ST*
(UROP Course: UROP1100, Summer 2013)

The purpose of this project is to simulate the behavior of Br atoms on a Cu surface using the Metropolis Monte Carlo algorithm developed by Nicholas Metropolis et al. in 1953. In the experiment, when Br atoms were slowly cooled down on a Cu surface to a low temperature (~5K), they formed some steady islands whose characteristics were also affected by the different coverage of the atoms on the Cu surface. The “Br atoms” in the simulation conducted in this project also formed similar islands. The relationship between the forces (bonding and repulsion) in this process were finally decided by considering the differences in the size distribution, shape distribution and the pair correlation function of the simulation and experimental results.

Keywords – Metropolis Monte Carlo algorithm

Advisor: *LIN Nian / PHYS*
Student: *DU Zhiqian / PHYS-PM*
(UROP Course: UROP1100, Summer 2013)

Amorphous graphene is considered to be a two-dimensional Anderson insulator. The analogue of artificial amorphous graphene has been realized by depositing organic molecules on a metal surface placed under grid mode scanning tunneling spectroscopy (STS). In this project, the data are processed to remove noises and the finite-size-scaling behavior is investigated for evidence that the amorphous system is an Anderson insulator. The results do not provide concrete evidence of localization, as the method used is very sensitive to noises. Yet, some features suggest that the localization may exist while overweighed by the bulk states inside the metal substrate.

Monte Carlo Simulation of Two-dimensional Supramolecular Assembly

Advisor: *LIN Nian / PHYS*
Student: *FANG Yawen / SSCI*
(UROP Course: UROP1000, Summer 2013)

To better understand the mechanisms of two-dimensional single and multi-component metallo-supramolecular polymerization on an Au (111) surface, which has been studied using scanning tunneling microscopy (STM), a computer simulation program using the Monte Carlo method is introduced to simulate this self-assembling procedure. By varying different parameters such as temperature and the density and bonding energy of molecules, the effect on polymerization can be studied separately. In addition, the effects of temperature and molecule density on the heat capacity of the system are also discussed and the results of one- and two-component cases are compared. The comparison of the computer simulation and experimental results suggests that the simulation program needs improvement.

Advisor: *LIN Nian / PHYS*
Student: *LI Yuxiao / MAEC*
(UROP Course: UROP1000, Summer 2013)

The two-dimensional supramolecular assembly used to generate metal-organic coordination networks on an Au (111) surface is studied using scanning tunneling microscopy. The Monte Carlo method is introduced for use in the computer simulation to help analyze the mechanism and find the law governing the assembly's behavior. Based on previous studies on this topic, the influence that temperature, concentration, bonding energy and hopping time have on the system have been taken into consideration and certain conclusions have been drawn through the analysis of the simulation results. Moreover, a comparison is made between the similarities and differences of the one- and two-component systems.

Advisor: *LIN Nian / PHYS*
Student: *WU Qi / PHYS*
(UROP Course: UROP1000, Summer 2013)

Using a new program designed and programed to realize the original Monte Carlo method through direct sampling, this project discusses the influences and basic mechanisms of some primary factors such as environmental temperature, bonding energy and molecular pressure in the two-dimensional (2D) supramolecular self-assembly process. Generally, some famous phenomena such as kinetic traps are successfully observed in the simulation and the simulation result might theoretically prove that the two-dimensional supramolecular self-assembly in a zero-dimensional case could be practical and efficient. By applying the canonical partition function into the Monte Carlo system, a basically accurate equation is obtained, which makes the further description and prediction of the two-dimensional supramolecular self-assembly process possible.

Keywords—self-assembly; 0-demensional; MC; simulation; partition-function.

Advisor: *LIN Nian / PHYS*
Student: *ZHONG Junke / SSCI*
(UROP Course: UROP1000, Summer 2013)

To help in understanding the nature and the characteristics of supramolecular assembly, Monte Carlo simulation is performed. Figures and graphs show the supramolecular assembly under the influence of various factors, and the final results such as the number of bonds formed between the molecules and the heat capacity are explained.

Quantum State Calculation of Two-dimensional Supramolecular Nanostructures

Advisor: *LIN Nian / PHYS*
Student: *SAHA Shreya / PHY-PP*
(UROP Course: UROP1100, Summer 2013)

This project examines the behavior of surface electrons subjected to periodic potential applied to a surface. A suitable MATLAB program can simulate this physical system by numerically solving the two-dimensional Schrödinger equation. Hence, a MATLAB program is designed for the two dimensional potential pillars. The band structure and density of state (DOS) graph are modified with different input parameters and analyzed accordingly. Furthermore, the program can be modified to adapt to practical cases in the future.

Advisor: *LIN Nian / PHYS*
Student: *WU Wei Shiung Bernedict / APHYS-ST*
(UROP Course: UROP1100, Summer 2013)

The behavior of surface electrons subjected to periodical potential applied on a surface is investigated. A suitable MATLAB program is used to solve the two-dimensional Schrödinger equation. In this experiment, a triple potential pillar and kagome structure are designed using MATLAB. Ultimately, the behavior of the gap width appearing in the band structure is observed by modifying different input parameters and analyzing them accordingly.

Studies of Higgs Physics

Advisor: *SHIU Gary / PHYS*
Student: *LO Cheuk Yee / PHYS*
(UROP Course: UROP1100, Summer 2013)

In this project, I read chapters 1-4 of the "Introduction to Elementary Particles" by David Griffiths.

Advisor: *SHIU Gary / PHYS*
Student: *XU Wenhao / PHYS-PM*
(UROP Courses: UROP1100, Spring 2013;
UROP1200, Summer 2013)

We study slow-roll inflation with a potential characterized as a finite sum $\Sigma_n \lambda_n M_{pl}^4 \left(\frac{\phi}{M_{pl}}\right)^{\Delta_n}$ via a statistical approach. Given a set of $\{\Delta n\}$, we generate random Wilson coefficients λ_n and then calculate the possibility of producing 60-efolds and corresponding observables, scalar spectral index n_s and tensor-to-scalar ratio *r*, which are compared with the data from the Planck satellite. Improvements to the computer program in Mathematica are introduced, and some preliminary results are produced. The program, written in C, can produce more results that will advance the study of theoretical string theory models for our universe.

Studies on Cosmic Inflation

Advisor: *SHIU Gary / PHYS*
Student: *KALLE KOSSIO Yaroslav Felipe / PHYS-PM*
(UROP Course: UROP1100, Summer 2013)
YU Cheuk Yin / PHYS-PM
(UROP Course: UROP1100, Summer 2013)

We investigate a single-field slow-roll inflation scenario and work on inflation potentials approximated as a finite sum $\Sigma_n \lambda_n \phi^{\Delta n}$. We have developed a program in Mathematica that randomizes the Wilson coefficients λ_n for each potential of a given set of real indices, Δ_n, and calculates the probability of producing 60 e-folds, n_s and r. We are developing a C program that evolves the set Δ_n and finds the potentials to produce 60 e-folds of inflation and scalar spectral index *ns* and tensor-to-scalar ratio *r,* consistent with the Planck results.

Advisor: *SHIU Gary / PHYS*
Student: *YAM Yau Chuen / MATH-MP*
(UROP Course: UROP1100, Summer 2013)

In this project, I have learned a lot of the important concepts and techniques in particle physics. One of the most useful techniques was drawing Feynman's diagram and employing Feynman's Rules in calculation. I also learned how to deal with particle collision problems efficiently and consider the spins of e+/- and photons. Differential cross sections and decay rate are new information, and their calculation involves many of the techniques and concepts I studied in this project. I solve differential cross sections and decay rate for the annihilation of positron and electron to demonstrate my understanding.

Damage Spreading in Networks

Advisor: *SZETO Kwok Yip / PHYS*
Student: *LAM Ho Tat / PHYS*
(UROP Course: UROP1000, Summer 2013)

The spread of Ising model damage in a network is investigated in this project through studying first damage time (FDT), influent time and healing time. We study three homogeneous networks: a one-dimensional (1D) chain, a two-dimensional (2D) square lattice and d-regular tree networks. For the 1D chain, we discover the quadratics of the distance dependence of FDT and the linearity of healing time. For the 2D square lattice, we explore the temperature dependence of FDT for the spins at distance 1 and discover the fastest damage temperature. In terms of the spatial pattern of FDT, we discover its nonlinearity of the distance dependence of FDT. For the d-regular network, we analyze the damage and recovery speeds. We also look at the influent time in 2D Ising for single and double source where interference is found.

Evolutionary Computation for Optimization

Advisor: *SZETO Kwok Yip / PHYS*
Student: *WANG Mengxue / MAEC*
(UROP Course: UROP1100, Summer 2013)

In this project, the cryptoarithmetic problems are first introduced and several past methods used to solve them are reviewed. A genetic algorithm and some of its applications are then discussed. Next, a specific cryptoarithmetic puzzle is presented and several programs are written and discussed to solve it. The performance of the genetic algorithm on this combinatorial problem is shown and the efficiency of certain genetic operators is tested. Finally, restrictions are presented to reduce the search space and prove its advantages in solving the problem.

Prisoner Dilemma Game on Complex Networks

Advisor: *SZETO Kwok Yip / PHYS*
Student: *AMEND Andre Eugen Bernhard / PHYS-PP*
(UROP Course: UROP1000, Summer 2013)

We investigate the relative success of players with and without memory competing against each other in an iterated Prisoner's Dilemma game. A player with memory remembers the previous game and thus, unlike a player without memory, he or she has the ability to adjust the strategy based on his or her knowledge of the previous game's outcome. To further examine this ability, we introduce meta-strategies according to which a one-step memory player can modify his or her strategy when playing against a zero-step memory player. We particularly want to look at how the frequency of 'patient' and 'impatient' players' changes to their strategies compare.

Advisor: *SZETO Kwok Yip / PHYS*
Student: *SZE Wai Pang / PHYS-PM*
(UROP Course: UROP1300, Fall 2012)

The expanding cluster of cooperators is defined in the one-dimensional evolutionary Prisoner's Dilemma game. The survival of these expanding clusters is discussed in the context of the repeated Prisoner's Dilemma game with imitation and asynchronous updating procedure without noise. The decay rate of cooperators is analyzed numerically for different configurations for the Wheatstone Network. Using Monte Carlo simulations we find an interesting phase change in the decay rate of cooperator density. The expanding cluster has a stronger resistance against the invasion, with the density of the expanding cluster of cooperators reaching its maximum peak and then decaying to zero.

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

Advisor: *SZETO Kwok Yip / PHYS*
Student: *FOK Ho Kong Jason / PHYS*
(UROP Course: UROP1000, Summer 2013)

Community detection is a useful technique for analyzing real-life networks such as communities among dolphin networks. We review the precipitation method introduced by Tianzhu Liang (2011) used in community detection. Each link is assigned a mass and the lowest potential energy arrangement is determined to detect the community. The iterated Prisoner's Dilemma game on a network can have its cooperator density, and location varies a lot under different circumstances, but varying the network formation or the comparison rule and excluding some cluster formations are ways to alter the cooperator density over time and, thus, the locations of cooperators.

Advisor: *SZETO Kwok Yip / PHYS*
Student: *SORN Sopheak / PHYS-PP*
(UROP Course: UROP1100, Spring 2013)

The average path length is an aspect closely related to the concept of random walk in networks. In this paper, the average path lengths of Erdös-Renyi (ER) and hexagonal networks are examined. The average path length of a single ER network is found to be following a regular trend whose linearity breaks down at a low connection probability, whereas the average path length of an ER network which consists of two constituent networks sharing an intersecting section is discovered to have a sharp change at a certain connection probability. Apart from the ER networks, the average path length of a hexagonal network is found be increasing under the Y-to-delta transformation and decreasing under the transformation to the heptagon-pentagon network.

Topology and Network Reliability

Advisor: *SZETO Kwok Yip / PHYS*
Student: *LUK Patrick Wan-hin / SSCI*
(UROP Course: UROP1000, Summer 2013)

Networks such as random, combined and small-world networks have their own network properties, and the average path lengths vary with the number of nodes and links. The average path length is an important characteristic of a network, and there are a few methods for calculating the average path length, such as considering each node pair or multiplying matrices. An approximated formula is also derived to relate the shortest average path length and clustering coefficient of small-world networks, and that formula is more accurate for large networks. Networks also have their reliabilities, and as a reliable network is necessary in some cases, a model for generating a reliable network is also derived.

Keywords: Average degree, average path length, clustering coefficient, connectivity, reliability, shortest average path length

Advisor: *SZETO Kwok Yip / PHYS*
Student: *SORN Sopheak / PHYS-PP*
(UROP Course: UROP1000, Summer 2013)

The average shortest path of an Erdös-Renyi network and a joint network are examined in this project. We then compare the average shortest path of a hexagonal network before and after it undergoes switching processes from two hexagons to a pentagon and a heptagon. The reliability of the Voronoi dual graph is measured to be decreasing under the T1 transformations. In addition, the effect of T1 increases the entropy of the Voronoi at an early stage but then reduces the entropy when the number of T1 is large. T2 transformation is incorporated in the last section to try to explain the evolution of soap froth, but the results do not match the experimental data.

Experimental Study of Colloidal Diffusion in an Energy Landscape

Advisor: *TONG Penger / PHYS*
Student: *XIAO Jinfeng / PHYS-PM*
(UROP Course: UROP1200, Fall 2012)

In this project, we apply the transition probability matrix theory to the study of molecular conformational transition. Our group has been working on introducing this method into the study of colloidal diffusion. For the diffusion in a two-dimensional hexagonal periodic energy landscape, the problem can be analyzed with a 2×2 transition probability matrix. After determining the range of the lag time in which the system is Markovian, the state transition rates can be calculated, and the height of the inter-state energy barrier can be roughly estimated. Knowledge about the shape of the energy landscape at the troughs and the peaks will improve the reliability of such estimations.

Plasmonic-enhanced Second Hormonic Generation in Metallic Nanostructures

Advisor: *WONG Kam Sing / PHYS*
Student: *GUO Yuxiang / APHYS-ST*
(UROP Course: UROP1000, Summer 2013)

We propose a new design for meta-material combining the classical one-dimensional split ring and the sharp tips geometries. This design contains a periodic array of gold circular 4-split rings with the same opening angles. Based on the FDTD simulation, strong intensity enhancement in the near-field due to both the narrow-spaced sharp tip and the coupling effect between the array of gold circular 4-split rings are predicted. The actual design has been fabricated by e-beam lithography and SHG using femtosecond laser excitation. Our result shows that the SHG signal is quite strong, such that we could fit the result, which is not as the simulation predicted.

Modelling Retina-LGN-V1 with Microsaccade Using Continuous Attractor Neural Networks

Advisor: *WONG Michael K Y / PHYS*
Student: *HAN Dongge / APHYS*
(UROP Course: UROP1100, Summer 2013)

Motivated by a previous thesis on microsaccade-related neural responses in the three-layer feedforward neural network of the visual system – retina, lateral geniculate nucleus (LGN) and primary visual cortex (V1) – with focus on the effects of short-term depression and retinal adaptation, the aim of this project is to study the existing network model and remodel the system using a continuous attractor neural network (CANN). Ultimately, two models are constructed – a two-layer LGN-V1 model based on the previous study and three-layer Retina-LGN-V1 model based on CANN. The detailed properties of and improvements to the second model are to be studied further.

Keywords – Microsaccade, continuous attractor neural networks, short-term depression, retinal adaptation

Memory, Spontaneous Behavior and Tracking performance in Continuous Attractor Neural Networks

Advisor: *WONG Michael K Y / PHYS*
Student: *MAO Hongzi / PHYS-PM*
(UROP Courses: UROP1100, Spring 2013;
UROP1200, Summer 2013)

In the first part of this project, I investigate the storage capacity of continuous attractor networks (CANNs) that store multiple charts. In the second part, I study a CANN model with short-term depression and focus on the relation between spontaneous movements of neuron activities and the tracking behavior of the network responding to moving external stimuli. In particular, the phase boundaries for these two aspects coincide well. A generalized theory is proposed based on the same principle as the fluctuation-response theorem in statistical physics, and the same key predictions are tested in two other specific CANN models: networks with spike frequency adaptation and two-layer networks.

Keywords – Continuous attractor neural networks, short-term depression, spike-frequency adaptation, two-layer networks, fluctuation response theorem

Wireless Sensor Networks

Advisor: *WONG Michael K Y / PHYS*
Student: *WONG Ka Hin / PHYS-PM*
(UROP Course: UROP1000, Summer 2013)

Before working on the project in summer, I had learnt some basic concepts of MTR Network, formulas and properties of goods transportation network, and I studied C++ programming from the COMP1002 lecture notes by myself. Then I made use of what I had learnt to construct some regular networks randomly and further analyzed these networks. I tried to identify the flaws of the programs I constructed and improved them by adding in more functions.

Elastic Wave Metamaterials

Advisor: *YANG Zhi Yu / PHYS*
Student: *AU-YEUNG Ka Yan / PHYS*
(UROP Course: UROP1000, Summer 2013)

Increasingly more researchers are investigating membrane-type acoustic metamaterials (MAMs). In this project, we demonstrate the use of MAMs to produce the resonance of two frequencies that correspond to its first and second eigenfrequencies. They lay within the low frequency regime of 50-1500 Hz. With an orifice, most of the wave can transmit, but with MAMs, the wave with the corresponding frequencies is stopped.

Advisor: *YANG Zhi Yu / PHYS*
Student: *TANG Suet To / PHYS-PM*
(UROP Courses: UROP1100, Spring 2013;
UROP1000, Summer 2013)

The absorption of low frequency sound is a famous topic in the development of devices and *architecture* because the sound waves in *ventilation systems* generate vibrations and reduce the height limit of buildings and damage devices. In general, thick plastic and cement are used to absorb sound waves, but because they are heavy and large, the production cost and design limitations are high. To tackle this problem, the development of new types of material with new absorption sound wave principles is needed. Professor Yang's research team has designed a metamaterial to solve this problem, and my project is to test the efficiency of new shapes of this material in absorbing the sound waves on a metal plate.

Advisor: *YANG Zhi Yu / PHYS*
Student: *YAM Yau Chuen / MATH-MP*
(UROP Course: UROP1100, Spring 2013)

Traditionally, it is difficult to absorb or reflect low frequency sound with thin, light material due to the mass density law. Professor Yang has proposed a new metamaterial comprising a rubber membrane and small masses on the surface that can do the job efficiently despite being thin and light. With this material, the frequency of sound being reflected can be controlled by changing the mass on it. To be more flexible in producing the material, we want to find a new way to control that frequency. We propose adding rings around the mass to change the mass distribution, and our results show that doing so really affects the vibrational eigenmodes of the system.

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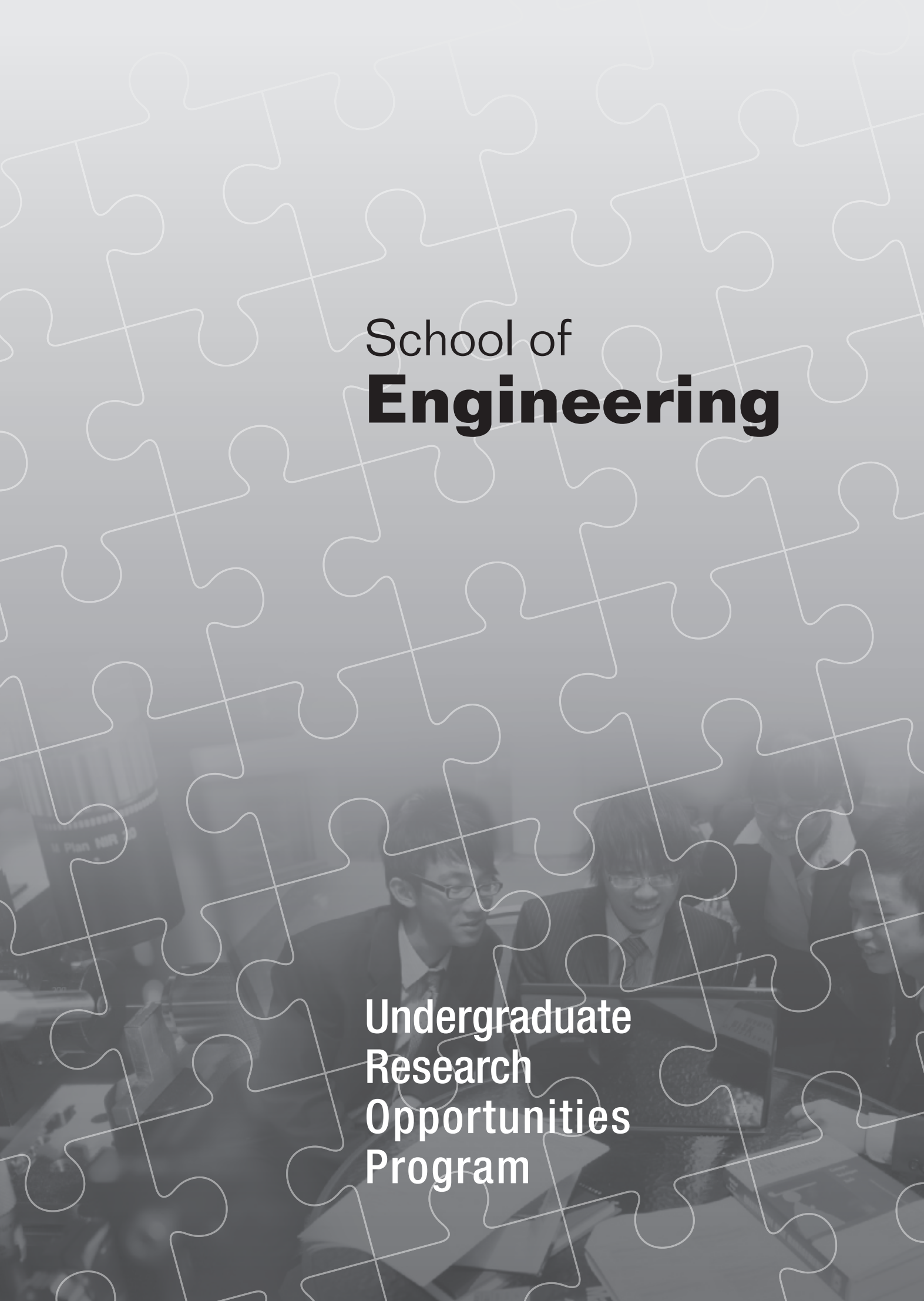


Undergraduate Research Opportunities Program

Department of Chemical and Biomolecular Engineering

Biomedical Applications of In Situ Hydrogel

Advisor: *CHAU Ying / CBME*
Student: *CARIM Sean / BIOL*
(UROP Course: UROP1000, Summer 2013)

Polymers capable of chemical and physical interaction with mucus glycoproteins by bonding with glycoprotein thiol groups are new and exciting options in the pursuit of more effective mucoadhesive compounds. When acting as drug carriers, these polymers, through such chemical interactions, greatly increase drug retention on mucosal surfaces, including that of the cornea. As vinyl sulfone (VS) groups react efficiently and at mild aqueous conditions with thiol groups by a process termed “thiol-Michael addition”, we have reason to believe that VS-functionalized polymers have the potential to become valuable mucoadhesive tools. The aim of our project was to design and commence tests to validate more in-depth investigation into the precorneal mucoadhesion properties of such polymers.

Keywords – mucoadhesion, mucoadhesive drug delivery systems, mucoadhesive materials.

Cosmetic Application of In Situ Hydrogel

Advisor: *CHAU Ying / CBME*
Student: *VILLAROMAN Andrea L / CBPE*
(UROP Course: UROP1100, Fall 2012)

Biodegradable hyaluronic acid (HA)-based dermal fillers have been widely used for aesthetic and medical tissue augmentation purposes. However, the existing commercial dermal fillers are limited in their range of controllable mechanical properties. In this project, we describe a novel injectable in situ hydrogel tuneable over a range of mechanical properties (295-6881Pa) and gelation kinetics. Chemical substitutions of hydroxyl groups for HA with vinyl sulfone and vinyl sulfone-thiol allow a cross-linking reaction to occur in physiological conditions via the thiol-Michael ‘click’ method. The storage modulus and the time to sol-gel transition is evaluated using dynamic mechanical analysis. Two formulations are examined for in vitro study and degradation is concentration dependent. Histological assay shows us that the hydrogel formulations have negligible cytotoxicity. Finally, a study of in vivo degradation in a small animal model suggests that the hydrogel formulations have longer persistence when compared to commercial dermal fillers. Taken together, optimized hydrogel parameters (molecular weight, degree of substitution and w/v% concentration) allow for the control of formulations that are promising for use as biomaterials for aesthetic and medical injection.

Keywords – hyaluronic acid, dermal filler, tissue augmentation, in situ hydrogel

Making of Lithium Ion Batteries and Testing Their Performance

Advisor: *CHEN Guohua / CBME*
Student: *NAGARI Kenro / CENG*
(UROP Course: UROP1000, Summer 2013)

Energy storage has become an increasingly important topic given its demand in powering electronic devices from laptops to smart phones. The Li-ion battery has been deemed superior to other batteries. In this project, Li-rich layered oxide is synthesized and then modified to optimize its performance. The $MnCO_3$ and mesoporous Mn_2O_3 morphology (porosity and uniformity) is observed. During the experiment, different compositions of the starting chemicals ($MnSO_4 \cdot H_2O$ and NH_4HCO_3) were used and the as-prepared sample is observed on SEM. The objectives of this project are to understand the Li-ion battery working mechanism and test its performance, e.g. rate its capability and cycling performance.

Advisor: *CHEN Guohua / CBME*
Student: *YEOH Keat Ping / CENG*
(UROP Course: UROP1000, Summer 2013)

In this project, the structure of the manganese (II) carbonate precursor is discussed in terms of morphology, particle size and uniformity. Manganese (III) oxide prepared from manganese (II) carbonate is also explored. As the manganese (II) oxide is later used as an electrode in coin cells and the porosity of the manganese (III) oxide is a crucial factor in its performance as an electrode, the pore density and size of the manganese (II) oxide electrode material is examined in relation to the performance of the coin cell. An overview of the electrochemistry within the coin cell is also provided.

Intelligent Process Monitoring and Control System

Advisor: *GAO Furong / CBME*
Student: *LIU Xinlu / CBPE*
(UROP Course: UROP1000, Summer 2013)

Manufacturers who use injection molding to create plastic products are upgrading, enhancing their standards and hence the quality of their standards and precision. To stay competitive in the market, manufacturers need a better understanding of and control over the injection molding process. Process monitoring, in which the transducer is a key element in plastic state detection, is important. In this project, a transducer is designed for point monitoring by measuring the capacitance variations inside the mold. Both the design and the insulation between the transducer and the mold are essential, with the insulation method choice being the most problematic element due to the extreme working condition of the transducer compared with most of the insulation materials.

Improving the Efficiency of Spectral Library Searching in Mass Spectrometric Data Analysis

Advisor: *LAM Henry H N / CBME*
Student: *YI Bairen / COSC*
(UROP Courses: UROP1100, Spring 2013;
UROP1200, Summer 2013)

High throughput shotgun proteomics has been well developed with the aid of the latest mass spectrometry technology, and state-of-the-art software has been designed to achieve automated peptide identification by searching MS/MS spectra against a protein sequence database or spectral library with the aid of modern computational tools. To achieve the ultimate goal of increasing the number of correct peptide identifications at a given error rate, the scoring algorithms incorporated in these searching software may be designed of complications or even complex pre- and post-processing steps, which greatly increases the difficulty of accurately estimating the error rate of their output peptide identifications. Several of the issues and controversies common in the MS/MS proteomics community are addressed in this review, including multiple definitions of identification error rate, target-decoy approach and statistical or machine learning approaches employed to increase/validate peptide identifications.

Bioplastic Production from Food Waste

Advisor: *LIN Carol S K / CBME*
Student: *LIU Xinlu / CBPE*
(UROP Course: UROP1100, Fall 2012)

Poly-3-(R)-hydroxybutyrate is a bioplastic produced by micro-organisms as an energy storage material. In this project, we used Halomonas boliviensis and applied a single variable method to determine the peak for producing the PHB from Halomonas fermentation. To detect the quantity of the obtained raw material, gas chromatography (GC) and thermogravimetric analysis (TGA) were applied. The object of this project was to investigate which detection method was better for determining the amount of PHB in the sample and how to improve the current method. The research showed that although there are still some minor defects in both methods, they are acceptable for research in the current stage.

Advisor: *LIN Carol S K / CBME*
Student: *NG Wai Ming / CHEM*
(UROP Course: UROP1100, Fall 2012)

The emergence of new infectious diseases, the resurgence of several infections thought to be controlled and an increase in bacterial resistance have created a demand for studies directed toward the development of new antimicrobial agents. This project evaluates the antibacterial activity of *Abrus cantoniensis* using an agar well diffusion method. The bacteria used are *E-coli*.

Recovery of PHB from Bakery Hydrolysate

Advisor: *LIN Carol S K / CBME*
Student: *LAM Man Yee / SSCI*
(UROP Course: UROP1000, Summer 2013)
YEUNG Hiu Lam / SSCI
(UROP Course: UROP1000, Summer 2013)

Hydrolyzed bakery waste contains high glucose content, which can serve as a cheap carbon source for the production of biodegradable plastic polyhydroxybutyrate (PHB) by a bacterium, *Halomonas boliviensis.* This technique would relieve food waste disposal problems and contribute to the development of biodegradable plastics. This project optimized the production yield of PHB from bakery waste. Bakery waste hydrolysates were obtained from enzymatic hydrolysis by a fungus, *Aspergillus awamori,* resulting in about 50 g/L and 100 g/L glucose concentration when using sea and fresh water, respectively. The hydrolysates were employed as rich carbon sources for PHB production by *Halomonas boliviensis* LC1 in shake flasks and fermenters. The freeze-dried cells were digested by concentrated sulfuric acid and quantified by HPLC for their PHB content.

Advisor: *LIN Carol S K / CBME*
Student: *LIN Hei Tung / CBPE*
(UROP Course: UROP1000, Summer 2013)

In this project, an enzyme extract containing glucoamylase and protease was produced by *Aspergillus oryzae* in solid-state fermentation using pastry waste. The medium condition for enzyme production was optimized and we found that the optimal condition for fermentation is a substrate with 1% sucrose and 1% peptone at pH 7. The enzyme extract was further characterized and consists of more than one protease. Moreover, the enzyme extract can be used for mixed food waste hydrolysis in the production of a FAN-rich fermentation media.

Screening Methods to Determine Antibacterial Activity of Natural Products

Advisor: *LIN Carol S K / CBME*
Student: *LIU Xinlu / CBPE*
(UROP Course: UROP1100, Spring 2013)

The history of Chinese people using Chinese medicine herbs to treat disease is very long. Therefore we consider that there will be antibacterial material inside the herbs. In this project, we applied the well-variant diffusion method to identify the antibacterial substances present in the herbs and measure their relative quantity. We evaluated the anti-fungal activity of Camille (a kind of flower) and magosteen against *awamori* and *oryzae.* From the first batch of results, it was found that the effective ingredient for both mangosteen and the flower was the methanol extraction. However, from the second batch of results, the only definite effective substance found was the ethanol extraction from the flower. The inaccurate nature of biology tests and the problems happened when handling the samples may be some of the possible reasons which led to the discrepancy. More tests will have to be conducted for a more accurate result.

Sustainable Biorefinery Concept based on Microalgal Biomass Produced from Mixed Food Waste Hydrolysate

Advisor: *LIN Carol S K / CBME*
Student: *CHANDRA Fransiscus Leo / CBPE*
(UROP Course: UROP1000, Summer 2013)

Glucose, free amino nitrogen (FAN), and phosphate are recovered from food waste in the form of a hydrolysate by fungal hydrolysis using proteases, glucoamylases and phospholitic enzymes from *Aspergillus awamori* and *Aspergillus oryzae*. Pure hydrolysate with 54.45 g glucose, 0.89 g FAN, and 3.32 g phosphate can be recovered from 100 g (dry weight) of mixed food waste after 48 hours. Further addition of fungal alpha-amylase, glucoamylase and fungal acid protease to the hydrolysate can increase the yields of glucose and FAN. Results of this study showed the potential of food waste hydrolysate to be used as a culture medium and nutrient source in microalgae cultivation.

Keywords – Glucose, free amino nitrogen, phosphate, food waste hydrolysis, enzymes, *Aspergillus awamori, Aspergillus oryzae*

Molecular Dynamics Simulation for Graphene Hybrids

Advisor: *LUO Zhengtang / CBME*
Student: *DIKKA Himanshu / MECH*
(UROP Course: UROP1100, Fall 2012)
LOHIYA Lokesh Narendra / CENG
(UROP Course: UROP1100, Fall 2012)

In this project, we use molecular dynamics to investigate the dynamics of a fluorescent probe system composed of graphene, a single-strand DNA and a small molecular fluorescent probe. We use software such as VMD and NAMD to conduct simulations of the aforesaid topic to achieve the desired result, as discussed in the progress report on the percentage of the research that has been completed during the Fall semester 2012 at HKUST.

Preparation of Topological Insulator by Chemical Vapor Deposition

Advisor: *LUO Zhengtang / CBME*
Student: *MENG Meng / CENG*
(UROP Courses: UROP1100, Spring 2013;
UROP1200, Summer 2013)

The goal of this project is to optimize methods for the synthesis of Bi_2Se_3 crystals by chemical vapor deposition (CVD), and discover new conditions for growth on new substrates such as graphene by controlling the synthesis time, flow rate and temperature. We successfully grew a crystal of Bi_2Se_3 on the graphene substrate with a diameter of ~ 3 μm. The optical, transmission electron microscopy (TEM) and atomic force microscopy (AFM) images were used to characterize the synthesized Bi_2Se_3 single crystal.

Preparation of Graphene based Electrodes

Advisor: *LUO Zhengtang / CBME*
Student: *WONG Tsz Cheuk / CENG*
(UROP Course: UROP1000, Summer 2013)

In this project, we describe how to make a full supercapacitor cell and use it as an energy storage device. Our aim is to make a cell electrode using reduced graphene oxide and test its electrical properties. The first step is to oxidize the expanded graphite to create graphene oxide, which we then reduce at 150℃ under low pressure to obtain reduced graphene oxide. Second, we mix the reduced graphene oxide with the binder to produce a slurry, which we press onto Ni foam to make the electrode. Finally, we test the battery using an electrochemistry work station.

Production Large Area Uniform Single-Crystal Graphene Films

Advisor: *LUO Zhengtang / CBME*
Student: *ZHOU Zixu / CBPE*
(UROP Course: UROP1000, Summer 2013)

Graphene has become a hot topic in material research, believed to be promising for use as electrode material due to its porous structure and high surface area ratio. This project discusses the best condition for synthesizing a graphene film with fewer layers and a larger area. I elaborate the steps for synthesizing graphene with nickel foam as a substrate using a chemical vapor deposition (CVD) method, and introduce the experimental outcomes. I also review and summarize the literature on this topic to illustrate my understanding of this project.

Chemical Engineering and Society

Advisor: *MAK Andrew T C / CBME*
Co-advisor: *LIU Yuanshuai / CBME*
Student: *LEE Hang Ling / ENGG-A*
(UROP Course: UROP1000, Summer 2013)

This project comprises two parts. In the first part, I investigate the challenges faced by Clear the Air, a local non-governmental organization (NGO) and suggest corresponding solutions. In the second part, I describe my experiences in the Rooftop Farm Program – a meaningful endeavor organized by the owner of a rooftop who is willing to devote himself to contributing to a greener life. I provide details about the rooftop farm and descriptions of some of the plants in addition to familiarizing myself with the other NGOs and social responsibility organizations in the same building.

The Effect of Particle Size on Solids Suspended in a Stirred Tank Reactor

Advisor: *MAK Andrew T C / CBME*
Co-advisor: *HUI Chi Wai / CBME*
Student: *LAU Tung Kwok / SENG*
(UROP Course: UROP1000, Summer 2013)

Zwietering (1958) suggested that minimum impeller speed $N_{js} = s\ \gamma^{0.1}\ (g\ \Delta\rho/\rho L)^{0.45}\ dp^{0.2}\ X^{0.13}\ D^{-0.85}$, with the size of the particle being one of the parameters affecting its minimum suspension speed, such that $N_{js} \alpha d_p^{0.2}$. Although this is widely accepted, numerous papers have proposed that the exponent of d_p on N_{js} is not that simple. Based on the literature, Shamlou and Zolfagharian (1990) found that the exponent of particle size (dp) on N_{js} has a range of 0 to 0.67. Experiments have tried to make particle size affect complete solid suspension, and many have used different solid concentrations, vessels and impeller geometry such that the effect of particle size changes accordingly.

Batch Kinetic Studies of Heavy Metals Removal from Wastewater

Advisor: *MCKAY Gordon / CBME*
Student: *CHEN Xi / CBPE*
(UROP Course: UROP1100, Spring 2013)

Heavy metal pollution is a serious environmental issue threatening living organisms. This project focuses on the adsorption of heavy metals in solution by exposing wastewater to adsorbents. In the experiment, NH2MCM41 were synthesized in a lab to act as the adsorbent. Zinc sulfate solutions with different concentrations were used in the batch experiment and samples were withdrawn during the adsorption process. ICP-AES was then used to determine the concentration of zinc ions in each sample and study the effect of initial metal concentrations on adsorption. The pH values of the samples were also measured to discover how the pH changes during the adsorption process.

Dye-sensitized Solar Cell

Advisor: *YEUNG King Lun / CBME*
Co-advisor: *HAN Wei / CBME*
Student: *HUANG Renjing / SENG*
(UROP Course: UROP1000, Summer 2013)

This project reviews the materials needed and procedure for assembling a dye-sensitized solar cell (DSSC). During calibration, we try TiO_2 particles and TiO_2 nano-tubes and then demonstrate the incorporation of different carbohydrates (sucrose/fructose/glucose) into the TiO_2 active layer. Carbohydrates are green materials that produce some remarkable effects in the catalyst production. The TiO_2-carbohydrate composite electrode is prepared by direct mixing and double coating methods and the composition of the composite electrode paste is confirmed by Raman spectroscopy. We find no carbohydrate after preparation, but do note bonds containing carbon atoms. The performance of the DSSCs (prepared using different methods) will also be tested.

Keywords – carbohydrate; titanium dioxide; dye-sensitized solar cell

Advisor: *YEUNG King Lun / CBME*
Co-advisor: *HAN Wei / CBME*
Student: *LIN Jing / CBPE*
(UROP Course: UROP1000, Summer 2013)

Dye-sensitized solar cells (DSSCs) are attracting increasing attention due to their low cost and relatively high efficiency and stability [1-23]. Since the first dye-sensitized nano-crystalline solar cells developed in the 1990s, DSSCs have witnessed a significant improvement in the conversion yield from 7.1% to the presently certified efficiency of over 10% [24]. Nanostructured materials offer new opportunities for enhancing the photovoltaic efficiencies of DSSCs by improving the injection of electrons from photoexcited dye complexes into the conduction band of semiconductor substrates [25]. However, the chemisorption of dye on the semiconductor's surface is subjected to the capacity of the mesoporous film layer, which is composed of a network of TiO_2. The idea emerged to use dye-doped TiO_2 nano-tube arrays to replace conventional dye absorption on titanium dioxide film, and photoelectrodes are then employed and the cell's performance is tested.

Keywords – dye-sensitized solar cell; dye-doped TiO_2 nanotube; Photovaltaic performance; Photoeletrode

Advisor: *YEUNG King Lun / CBME*
Co-advisor: *HAN Wei / CBME*
Student: *WEI Yiran / SSCI*
(UROP Course: UROP1000, Summer 2013)

The dye-sensitized solar cell (DSSC) is a further step toward harnessing solar energy, following the traditional silicon p-n junction solar cell. Benefits of DSSCs have been discovered, such as lower cost, higher efficiency, easier operation and long-term stability, compared with other types of solar cells. This is prompting researchers to study DSSCs not only in laboratory settings, but also for commercial use. This project manifests the concrete procedure for assembling a basic DSSC with TiO_2 P25 and some new nano-structured materials developed in the laboratory. Because this involvement of new materials is immature, it remains difficult to determine their eligibility for use in DSSCs.

Keywords – dye-sensitized solar cell, TiO_2 P25, pure anatase TiO_2, nanotube, Ag-doped nanotube, characterization

Department of Civil and Environmental Engineering

Harvesting Energy from the Vibration of Long-Span Bridges

Advisor: *CHANG Chih-chen / CIVL*
Student: *LOONG Cheng Ning / CIVL*
(UROP Course: UROP1100, Spring 2013)

Harvesting energy from vibrations is considered a green technology suitable for saving energy to fulfill the world's substantial energy demands. Specifically, the wasted mechanical energy from large-scale buildings and infrastructures is captured. The technology that is most suitable for harvesting energy is the tuned mass damper (TMD), and the majority of previous research explores the dissipation of energy using TMD without addressing the practicality of its use. Therefore, this project integrates this type of technology with a bridge using an equation I developed to estimate the harvested energy. The simulation results are examined to investigate the amount of energy harvested from the bridge by treating it as a simply supported beam.

Investigating the Mixing of Gravity Currents Using the Light Attenuation Technique

Advisor: *KIKKERT Gustaaf A / CIVL*
Student: *SETIASABDA Ezra Yoanes / CIEV*
(UROP Course: UROP1100, Fall 2012)

It is well known that when two fluids with different specific densities are adjacent to each other, there is an unbalanced horizontal density gradient that results in an adjustment process that occurs to achieve equilibrium where the less dense fluid is vertically above the more dense fluid. This project uses the light attenuation technique to investigate the aforementioned phenomenon, which is commonly found in estuaries where there is an unbalanced density gradient due to the different densities of salt and fresh water. The characteristics of the mixing process, such as the velocity and the thickness of shear layers, are investigated.

Climate Change Impact Analysis for Hong Kong and Nearby Regions

Advisor: *LAU Alexis K H / CIVL*
Student: *LAU Yan Wai / BICH*
(UROP Course: UROP1100, Spring 2013)

Climate is closely related to daily life, as it plays a central role in global economic and social sectors. For thousands of years, we have been adapting to the present climate system. However, there is evidence that the stability of the global climate is decreasing. Some projections suggest that heat waves will be more intense, more frequent and longer lasting in a future warmer climate. Precipitation intensity is also expected to increase, but with a longer return period. There is also a tendency for drying in the mid-continental areas during summer, indicating a greater risk of droughts in those regions (IPCC 4th assessment report 2007).

As the impact of climate change has surfaced over the past decade, impact analyses of climate change have become vital to allow governments to mitigate climate change induced risk. Most of the impact analyses and predictions have focused on physical parameters, with predictions based on the probability of extreme climate events. However, factors beyond the physical environment, such as the social environment, can also be a key determinant of the impact. In particular, a new risk analysis framework was raised in an IPCC special report on Risk Management and Adaptation for Extreme Events and Disasters (IPCC 2012).

In this project, the highlights of this IPCC report are summarized and reviewed, and the suggested risk framework is adopted for use in the further analysis of climate change risk in terms of heat wave, heavy precipitation and tropical disease in Hong Kong and nearby regions. The literature is reviewed and the social factors affecting the three climate change factors are identified. A case comparison is made to project the possible impact of the three climate extremes in Hong Kong and nearby regions.

Advisor: *LAU Alexis K H / CIVL*
Student: *NAM Junghyun / EVMT*
(UROP Course: UROP1000, Summer 2013)

The control of the SARS outbreak in Hong Kong relied primarily on its quarantine strategy, in which the rapid diagnosis of individuals was followed by isolation. This project uses nine parameters that suit Hong Kong's data and perform uncertainty and sensitivity analyses on the model parameters and reproductive number R_0. The results indicate that even under perfect isolation, there is a 27% chance of the epidemic being sustained. Meanwhile, parameters l and β are proven to have the greatest influence on R_0, but other parameters also have notable effects on the result. Therefore, rather than entirely relying on quarantine, a comprehensive approach of simultaneous control of multiple parameters is recommended.

Application of FBG Sensing Technique on Shrinkage Strain Measurement for Cement-based Composites

Advisor: *LI Zongjin / CIVL*
Student: *SUN Lei / CIGBM*
(UROP Course: UROP1000, Summer 2013)

Early-age shrinkage is responsible for early cracking in concrete, which is harmful to its durability and serviceability. However, traditional strain gauges and other indirect methods have difficulty monitoring the shrinkage accurately and continuously right after casting, when the concrete is still in its liquid stage. A new technique, fiber Bragg gratings (FBGs) (based on a periodic modulation of the refraction index along the length of optic communication fiber), has been adopted to investigate early-age shrinkage in cement-based composites. Early-age strain and temperature changes in different places along the longitudinal direction were obtained using FBGs. By monitoring the two specimens together, the w/c ratios influence on early-age autogenous shrinkage can also be identified.

Keywords – fiber Bragg gratings; fiber-optic sensor; strain sensor; early age shrinkage

Green Slope Engineering for Hong Kong

Advisor: *NG Charles W W / CIVL*
Student: *CHEUNG Yu Tang / CIVL*
(UROP Course: UROP1100, Spring 2013)

This project investigated tree-induced suction and its variability among its own species. To understand suction distribution, field monitoring was conducted on a slope vegetated with *Schefflera heptaphylla* while the plant variability effect was studied in a plant controlled atmospheric room where atmospheric and soil parameters were well controlled. *Schefflera heptaphylla* is a commonly found tree species in Hong Kong, India and many parts of China. During a month-long period of field monitoring, suction was measured using jet fill tensiometers at three different depths. Atmospheric parameters such as air temperature, relative humidity and radiation energy were also measured simultaneously. Meanwhile, in a laboratory, 12 samples of *Schefflera heptaphylla* were vegetated in pots and monitored for around 10 days. The surface soil was covered with masking tape to prevent evaporation. During the monitoring period, the plants' water uptake (by weight) and suction were measured and the relationship between suction and water uptake in trees was highlighted. Any effect of variability was understood from the number of leaves produced by the tree.

Advisor: *NG Charles W W / CIVL*
Student: *TAM Ka Lok / SENG*
(UROP Course: UROP1100, Summer 2013)

The terrain in Hong Kong is hilly and rugged. To prevent landslides, engineers typically use concrete to build retaining walls – an environmentally problematic, high-maintenance procedure. In this green slope engineering project, how the common vegetation in Hong Kong helps maintain shallow soil slope stability is examined. This live slope cover is more environmentally friendly, as it is sustainable and almost maintenance free. We focus on the data extracted from tensiometers from the campus slope and those generated in the sieve testing.

Disinfection Byproduct Degradation in Simulated Drinking Water by UV-assisted Advanced Oxidation Processes

Advisor: *SHANG Chii / CIVL*
Student: *MAK Pak Long / CIVL*
(UROP Course: UROP1100, Spring 2013)

Disinfection byproducts (DBPs), formed during the water disinfection process, have been proven to have negative human health consequences. Many methods have been developed to remove these unwanted DBPs over the past few decades. One of these removal methods is UV irradiation, which includes UV photolysis and the UV-assisted advanced oxidation process (AOP). Accordingly, this project investigates the effects of UV irradiation on a targeted DBP, dichloroacetonitrile (DCAN), to compare the efficiency of UV and UV-assisted AOP. The results show that the UV/chlorine AOP is more effective than the UV photolysis. However, another disinfection byproduct, trichloroacetonitrile (TCAN), is formed during the UV/chlorine AOP.

Innovative Iron-based Process for Odor Control in Storm Water Drains in Tidal Areas

Advisor: *SHANG Chii / CIVL*
Student: *SU Qida / CIEV*
(UROP Course: UROP1100, Fall 2012)

The odor nuisance of the hydrogen sulfide generated in box culverts has raised public concern in Hong Kong. Thus far it has been feasible to use granular ferric hydroxide (GFH) for sulfide control in the sediment phase in previous batch tests. In this project, the effect of the GFH dosing method on sulfide removal in the sediment phase is investigated in a box culvert model. The result shows that GFH dosing is helpful for sulfide removal in the sediment phase, and the embedded GFH dosing is more efficient than the surface-covered dosing.

Water Purification Units for Low-income or Developing Countries and Regions

Advisor: *SHANG Chii / CIVL*
Student: *CHOW Jun Kang / CIEV*
(UROP Courses: UROP1100, Fall 2012;
UROP1200, Spring 2013)

This project focuses on modifying or forming water purification units for low-income or developing countries and regions. Palatable and potable drinking water is a vital issue concerning people around the world. Water contamination due to pollution, mining activities, deforestation, etc. has caused the quality of water to drop below the established drinkable standard. Solar power has become a more common method for producing drinkable water. For example, the solar disinfection of water has been used to enhance the water quality to reduce diarrheal diseases such as cholera. In this project, a solar-powered reactor is used to obtain drinkable water.

Advisor: *SHANG Chii / CIVL*
Student: *MENG Lingshi / CIVL*
(UROP Course: UROP1200, Fall 2012)

In this project, I construct a solar distillation system comprising a) the skeleton of a solar distillation system, b) the unit function of compartments, c) the material selection for the unit and d) modifications.

Earthquake Size Distribution and the Weibull Probability Function

Advisor: *WANG Jui-pin / CIVL*
Student: *HUANG Yuchen / CIVL*
(UROP Course: UROP1000, Summer 2013)

This project explores the relationship between an earthquake's size distribution and the Weibull distribution using the category recording earthquake in Taiwan. An earthquake is a natural catastrophe that cannot successfully be predicted. However, previous data can be used to find a distribution to fit the current data. The earthquake's size distribution can then be approximated by a specific known probability distribution. Because there are more than 50,000 previous samples, Excel will be used to analyze the data. The results will support a better understanding of the occurrence of earthquakes and improve the possibility of predicting a specific size of earthquake.

Earthquakes and the Poisson Distribution

Advisor: *WANG Jui-pin / CIVL*
Student: *TAM Ming Ki / SSCI*
(UROP Course: UROP1000, Summer 2013)

An earthquake is a natural hazard and its occurrence is assumed to follow some statistical models. In this project, we examine earthquakes in Taiwan by fitting the earthquake distribution (with respect to time) with a statistical model (Poisson distribution). For the fitting method, we perform statistical goodness-of-fit tests; specifically, chi-square tests analyzed by Microsoft Excel and Microsoft Visual Basic. The result shows that only earthquakes above a magnitude of 6.3 follow the Poisson distribution.

Development of GeoMEMS Sensors for Geotechnical Engineering Applications

Advisor: *WANG Yu-Hsing / CIVL*
Student: *TAN Pin Siang / CIEV*
(UROP Course: UROP1100, Spring 2013)

The GeoMEMS sensor is an ongoing project that strives to decrease the cost of remote monitoring using new types of sensors and their related electronics and software. To achieve this goal, the project is based around commercial off-the-shelf (COTS) electronics to provide functionality for as many parts as possible while still creating a reliable and capable system. The process involves the team rethinking data acquisition, data transmission and the storage stack. This sensing and acquisition suite is conceptualized to characterize the movement of unstable slopes and then to issue in-time landslide warnings.

The Development of a New Type of Sensor, Smart Soil Particle, for Slope Stability Monitoring

Advisor: *WANG Yu-Hsing / CIVL*
Student: *LOONG Cheng Ning / CIVL*
(UROP Course: UROP1100, Summer 2013)

Geotechnical engineers use different types of slope monitoring apparatus and sensors, such as piezometers and seismometers, to assess slope movements such as landslides, soil erosion and earthquakes. However, these methods are usually expensive and demand excessive human resources. Therefore, in this project, a new MEMS accelerometer – smart soil particle (SSP) – is developed to monitor slope movements. This miniature smart sensor is comparatively cheaper than the traditional monitoring devices. It is highly accurate, highly sensitive, easy to set up, easy to fabricate and can be controlled remotely and run automatically. A review of the traditional methods for monitoring slopes appears in the first section, followed by a discussion of the characteristics of this new type of MEMS sensor. A case study related to the Taiwanese earthquake and typhoon events is then investigated, followed by preliminary data processing and analysis to investigate the functionality of this new type of sensor. The drawbacks of the SSP are then discussed and some suggestions are presented to solve these problems. The last section concludes the project and discusses future research possibilities related to the application of this smart sensor.

Index terms – MEMS Sensors, Slope Monitoring System

An Exploratory Study of the Applications of Transparent Soils

Advisor: *WANG Yu-Hsing / CIVL*
Student: *CHOW Jun Kang / CIEV*
(UROP Course: UROP1100, Summer 2013)

Experimental models for measuring spatial deformation patterns within a soil mass are typically limited by the fact that soil sensors do not provide a continuous image of the measured continuum. Furthermore, the different characteristics of soil sensors (both static and dynamic) that react with the surrounding soils could alter the response of the measured continuum. The study of transparent slurry was originally done by Mannheimer (1990) and further developed by Iskander (1994) with the creation of three families of transparent soils: amorphous silica powder, silica gels and Aquabeads. In addition, another type of transparent soil using Nafion has been developed by a team of researchers from the James Hutton Institute and the University of Abertay Dundee (2012). In this project, the characteristics of transparent soils were developed and tested to find another suitable material for making synthetic transparent soil that is low cost and easy to prepare.

Evolution of Risks of Earthquake-induced Soil Deposits on Natural Terrains

Advisor: *ZHANG Li Min / CIVL*
Student: *YIU Wing Nam / CIGBM*
(UROP Course: UROP1100, Spring 2013)

An F-N diagram is one of the common approaches to evaluating the risk acceptability of a hazardous event. A risk acceptability criterion plotted on an F-N plot represents the level of acceptability toward risk for a particular group of people. Established risk acceptability criteria for some regions are taken as a reference for other regions in some circumstances. However, this assumption may lead to impracticable improvement requirements in some developing regions. Among the various industrial activities and regions across the world, this project focuses on the societal risk incurred by landslides in the Wenchuan earthquake zone, a remote and developing region in China. A risk acceptability criterion on an F-N plot with a steep slope and a higher probability is proposed to evaluate the conditions in Wenchuan and Hong Kong, where the risk acceptability criteria have been set up, quoting other risk assessment methods for other activities formulated by the Chinese government and experts. Societal risk acceptability criterion are quantified, an ALARP curve developed and an implementation curve established.

Triaxial Testing on Fiber-reinforced Sands

Advisor: *ZHAO Jidong / CIVL*
Student: *WONG Wai Chung / CIVL*
(UROP Course: UROP1000, Summer 2013)

Fiber addition is a new and efficient approach to soil reinforcement in geotechnical engineering. This project investigates the behavior of fiber-reinforced soil under various loading conditions – including the effects of confinement pressure, initial density and the percentage of fiber content reinforced – via triaxial experimental testing. The stress-strain relation between the fiber reinforced soil samples is studied, and the results show that the higher the fiber content and the denser the sample, the better the reinforcing effects of fiber that can be achieved. These findings can be applied to the treatment and reinforcement of loosely engineered slopes or backfills in Hong Kong.

Department of Computer Science and Engineering

Indoor Localization

Advisor: *CHAN Gary S H / CSE*
Student: *CHONG Bor Hung / CPGBM*
(UROP Course: UROP1100, Spring 2013)

This project explores indoor localization, a growing area of research with significant commercial potential.

There are three areas within the research team. One uses Wi-Fi to locate the user, another uses gyroscopes and accelerometers and the third area is the user interface. This project focuses on the Wi-Fi area. The project was basically a smaller version of the model made for the Hong Kong International Airport (HKIA). This version works for a small part of HKUST and the task was to compare different ways of locating the client in HKUST. Comparisons are made regarding the algorithms used in the calculations and the variables used to locate the client.

Advisor: *CHAN Gary S H / CSE*
Student: *LIM Junsea / COMP*
(UROP Course: UROP1100, Summer 2013)

Throughout the history of mankind, map makers have helped people become aware of where they are and where they are going. Location positioning methods have changed dramatically over the years, and their efficiencies have improved to a great extent. Modern advancements in location positioning and mobile computing have further fostered a strong attention on location-aware services that make the surrounding environment more transparent and informative. There are many strategies for outdoor positioning on mobile devices using technologies like the global positioning system (GPS). However, GPS radio waves fail to penetrate most building structures, which this leaves indoor positioning potentials untapped. In this project, an indoor localization system based on inertial sensors that receives signal strength indications for Wi-Fi is introduced and explored. This system's seamless positioning capabilities may allow mobile applications to be enhanced with range of location-aware services and features.

Keywords – Indoor localization; Fingerprinting; Location based service; Signal contour

Overlay and Peer-to-peer Multimedia Streaming

Advisor: *CHAN Gary S H / CSE*
Student: *FANG Peng-chi / CPEG*
(UROP Courses: UROP1100, Spring 2013;
UROP1000, Summer 2013)

In today's global network, applications are being built to stream live TV to personal computers and smart mobile phones. However, under heavy transmission loads, most of these applications cannot play video fluently on the client end. Thus, in this project, we research and develop an advanced peer-to-peer streaming technique for networks and put the concept into practice by implementing it on tablets and smart phones.

Advisor: *CHAN Gary S H / CSE*
Student: *HANN Evan / COMP*
(UROP Course: UROP1100, Fall 2012)

In this project, I have learned about computer networks, operating systems and software engineering by completing various tasks such as setting up virtual machines for deployment, developing watchdog applications, testing video streaming players and fixing the android client application.

Advisor: *CHAN Gary S H / CSE*
Student: *XIAO He / COMP*
(UROP Course: UROP1000, Summer 2013)

I have been a member of Streamphony for almost two months. Streamphony is a very complex and well-developed global streaming operation, and as such my goal in this project is to learn the basic structure and design ideas involved. Streamphony divides a stream at the root server into many proxies, each of which can get resources from other roots or proxies, enabling it to offer enough bandwidth for plenty of users. The content delivery network (CDN) cloud also decreases the delay.

Wireless Mesh and Networking

Advisor: *CHAN Gary S H / CSE*
Student: *CHANG Bing Yen / CPEG*
(UROP Course: UROP1000, Summer 2013)

In this project, we introduce and report the progress of an inertial navigation system (INS) that uses the inertial sensors of an Android handheld device to determine the user's location and displacement. The main features of this particular INS approach are sensor fusion, step detection and step length. The data from the different inertial sensors of the handheld device are combined and filtered, a process dubbed "sensor fusion", to obtain more accurate data. Relative displacement is calculated from the "number of steps" and "step length" of the user. However, the greatest challenge of this approach is step detection and step length measurement precise enough to reduce and possibly eliminate the margin of error.

Keywords – Inertial Navigation System, Android Device, Sensor Fusion, Step Detection, Step Length, Kalman Filter, Low-Pass Filter

Advisor; *CHAN Gary S H / CSE*
Student: *CHAU Ho Yin / COMP*
(UROP Course: UROP1000, Summer 2013)
POK Yan Ting / COMP
(UROP Course: UROP1000, Summer 2013)

In this project, an application programming interface (API) of Datagram Transport Layer Security (DTLS) protocol is built with the use of OpenSSL library in C language. Several functions are defined for the establishment of a data tunnel using such protocol and separated encryption and decryption that programmers can deploy at will. The functions are designed to be easily integrated, with sufficient flexibility, into custom settings. Testing is also performed to determine the speed of client connection, server acceptance, encrypting and decrypting. The result can be used as a benchmark for the API and different cipher methods of symmetric encryption. Programmers can then decide based on the adaptability of such protocol and choose which cipher method to use in balancing security and server throughput.

Advisor: *CHAN Gary S H / CSE*
Student: *LAU Chak Fu / COMP*
(UROP Course: UROP1100, Fall 2012)

Most Wi-Fi networks currently suffer from a variety of problems such as limited coverage and high interference. Lavinet, a project supported by HK Innovation and Technology Commission and carried out by Hong Kong University of Science and Technology, attempted to improve Wi-Fi data access. The purpose of the wireless mesh and networking project is to assist the Lavinet project group. I am learning the basics of networking, along with several web content management system (CMS) languages, and will ultimately design a framework for their Lavient project website.

Advisor: *CHAN Gary S H / CSE*
Student: *LAU Tsz Fung / COMP*
(UROP Course: UROP1100, Fall 2012)

Quality of service (QoS) is an important issue in any type of computer network. It ensures users that the network can share bandwidth fairly according to their needs and priority. In a Linux environment, QoS is mainly implemented by applying traffic control (tc) scripts. This project applies QoS to Lavinet, a wireless mesh network based on Layer 2 switching technology. The expected outcome of the project is to enable bandwidth control and prioritize traffic among different VLANs in the Lavinet network.

Development of Context-Aware Android Apps

Advisor; *CHEUNG Shing Chi / CSE*
Student: *HUANG Richeng / COMP*
(UROP Course: UROP1000, Summer 2013)
LU Yingjun / COMP
(UROP Course: UROP1000, Summer 2013)

Many Android applications still suffer from slowness in varying degrees. In this project, we try to identify the rudimentary cause; that is, the application design. We try to help the developers determine which parts of the codes have the potential to slow the application down. According to http://developer.android.com/, 100 to 200 ms is the threshold beyond which users will perceive slowness in an application. If component lifecycle handlers, which run in the UI thread (such as onCreate) and GUI event handlers (such as onClick) require more than 200 ms to finish, we may warn the designer that the chosen method has the potential to make the application sluggish, and improvements can be established based on this result.

Development of Location-Aware Android Apps

Advisor: *CHEUNG Shing Chi / CSE*
Student: *RAGHURAMAN Sathish / COMP*
(UROP Course: UROP1100, Fall 2012;
UROP1200, Spring 2013)

The Android operating system has emerged as the leading platform for Android applications. A new report has found that Android manufacturers shipped more than 60% of the 300 million smart-units (phones and tablets) that were sold in the first quarter of 2013. This huge demand for Android-enabled devices has led to a significant increase in the number of Android developers. An increasing number of programmers are learning to code in Android, which has led to a direct increase in the number of Android applications currently in circulation in global mobile markets. By April 2013, there were over 700,000 apps in the Google Play Store alone, and together they have received over 40 billion downloads thus far.

With such an exponential increase in the number of Android users and available applications, there is a pressing need for a way to analyze them, by checking the correct running of the application or energy efficiencies or monitoring for programming efficiency, etc. Android is unique in the sense there are no direct tools for analyzing apps coded for Android. Despite its association with the Java family, software that can analyze Java programs cannot analyze Android apps because are compiled from Java source into platform-specific Dalvik bytecode. To solve this glaring need, Octeau, Jha and McDaniel designed an algorithm for retargeting Android applications from markets to Java class files. This tool is named Dare and uses a new intermediate representation to enable fast and accurate retargeting. Another tool developed to translate .apk files to .class files is called dex2jar. In this project, I analyze the effectiveness of such Dalvik-Java bytecode translators and the quality of the translations they perform.

Database in the Cloud

Advisor: *GU Lin / CSE*
Student: *CHAN Chi Yee / ELEC*
(UROP Course: UROP1100, Summer 2013)

A cloud database functions through cloud computers and can be built by many computers by the virtual machine to be table- or key/value-based, given that the table-based options cannot easily run a huge data throughput. In this project, we focus on the concept of the key/value database and its implementation in handling petabyte data.

Distributed Algorithms for Cloud Computing Platforms

Advisor: *GU Lin / CSE*
Student: *POON Chi Hang / PHYS-PP*
(UROP Course: UROP1000, Summer 2013)
WONG Chun Yin / PHYS-PP
(UROP Course: UROP1000, Summer 2013)

User computing experiences have largely shifted from local machines to clouds. To push the development of cloud computing, LayerZero (L0) is invented to systemize a cloud's programming environment. A new language called c0 is developed to facilitate the programming of cloud software on L0.

By parallelizing existing algorithms using c0, the principles and skills in cloud programming on L0 can be familiarized for the later development of new software. The usability of c0 on cloud computing is evaluated for possible improvements and frequent-pattern mining algorithms are chosen for testing because they are widely applied in different areas for analyzing data and are valuable to machine learning.

Keywords - Cloud Computing; Parallelization; Frequent-pattern Mining

Advisor: *GU Lin / CSE*
Student: *XU Diwen / COMP*
(UROP Course: UROP1200, Fall 2012)

These days, people are surrounded by large amounts of data. We deal with data sizes that have increased from gigabytes to terabytes or even larger. Therefore, even powerful hardware and efficient algorithms are not sufficient and people begin to focus on cloud computing, which allows us to assemble hardware and software resources and distribute them in physical locations by network so that they can cooperate to complete a single computing task. In this project, I examine a new cloud computing framework called Layer Zero.

Advisor: *GU Lin / CSE*
Student: *YAN Jun / COMP*
(UROP Course: UROP1200, Fall 2012)

I began this project in the summer semester. This semester, I implement the algorithms learned previously, which involves programming. Although the algorithms are not difficult, there have been challenges in the process of transplanting these algorithms into the Layer Zero platform, but I have overcome them with my advisor's guidance. I have also worked to improve the algorithms to make them more efficient. Consequently, I am benefitting enormously from this project. I have a better understanding of the algorithms and my programming skills have improved significantly.

Advisor: *GU Lin / CSE*
Student: *YU Coleman / PHYS-PP*
(UROP Course: UROP1000, Summer 2013)

In this project, we introduce the importance and difficulty of the Multi-dimensional Knapsack Problem (MKP), the concept of Ant Colony Optimization (ACO) and how to use ACO to solve MKP. Given the characteristics of ACO, it can be implemented in parallel programming for cloud computing.

0-1 MKP is a problem of choosing some items that can maximize the profit without violating the constraints. It is important in financial and other management. Imagine you are freighter owner and containers have volume and weight. You freighter can only load a certain amount of containers. Containers also have different values and you want to maximize your profit. In this situation, you are in fact facing a two-dimensional 0-1 MKP.

Distributed Computing in a Virtual Environment

Advisor: *GU Lin / CSE*
Student: *WANG Bo / COMP*
(UROP Course: UROP1000, Summer 2013)

Layer Zero is a big virtual machine that aggregates numerous compute nodes, acting like a single computer through which thousands of tasks can run concurrently in a large and unified memory space. Given the rapid development of cloud computation and increasing importance of cloud-based computation in the past decade, people need a more efficient computational interface that can support datacenter-scale programming. Layer Zero's ingenious design effectively provides this service, meets people's demand and compensates for many of the weaknesses of the virtual machine monitor (VMM) used by many cloud systems. A new designed instruction set architecture (DISA), unified memory space and an inimitable parallelization mechanism (tasking and scheduling) all contribute to Layer Zero's success. K-medoids is one of the most famous and valuable data-mining algorithms used to group the large datacenter's data into several different classes by comparing the similarities. In this project, I use the k-medoids algorithm's high parallelism and massive computation feature to evaluate Layer Zero's performance and scalability.

System Software for Cloud Computing

Advisor: *GU Lin / CSE*
Student: *GAN Bo / COMP*
(UROP Courses: UROP1100, Spring 2013;
UROP1200, Summer 2013)

In the L0 system, the binary translator is an important module responsible for translating i0 instructions to x86_64 instructions for direct execution. The new implementation provides efficiency and correctness in complicated situations by carefully managing resources to prevent memory problems.

Advisor: *GU Lin / CSE*
Student: *HUANG Tianwei / COMP*
(UROP Courses: UROP1100, Spring 2013;
UROP1200, Summer 2013)

MapReduce is a cloud-based programming model introduced by Google. It simulates applications by dividing them into two phases: map and reduce. The power of MapReduce lies in its ability to greatly improve program execution to help fully use the physical computing power. Additionally, it also hides sophisticated load balancing work details from the programmer. TeraSort is an algorithm designed to make full use of the power provided by the MapReduce framework. It greatly improves the throughput compared with other sorting algorithms. Data locality can be also improved by further improving the algorithm.

Advisor: *GU Lin / CSE*
Student: *WANG Ding / CSIE*
(UROP Course: UROP1000, Summer 2013)

The word 'cloud' is becoming increasingly familiar to everyone. Cloud computing – distributed computing over a network – is always related to running programs on many connected computers simultaneously, and it is popular in marketing and among big companies.

Professor GU Lin and his team have implemented a newly designed cloud-based system, L0, which can be used for large-scale cloud computing and to effectively run programs. This team also developed a specialized programming language for the L0 system called 'C0', and its compiler (CC0).

In this project, I am familiarizing myself with C0 and its compiler with the aim of writing an inverted index program capable of testing L0's efficiency.

Keywords – Cloud computing, C0, inverted index, string

Advisor: *GU Lin / CSE*
Student: *XU Fang / ELEC*
(UROP Course: UROP1100, Spring 2013)

Cloud-based computation has become mainstream in web applications and a wide range of computational tasks. With the mighty capability of handling massive computational tasks, numerous programs in different fields are written to run in datacenters – large-scale cloud-based systems with thousands of loosely coupled computational servers that provide abundant computing resources. To use these resources effectively and raise the parallelism, a new cloud-based substrate (L0) has been developed for large-scale distributed computing.

In this project, I focus on mastering the L0 system and testing and developing the compiler (CC0) for language targeting.

Theorem Discovery in Game Theory

Advisor: *LIN Fangzhen / CSE*
Student: *HU Anbang / MATH-AM*
(UROP Courses: UROP1100, Spring 2013;
UROP1000, Summer 2013)

Last spring, this project explored good general conditions with the mathematical pattern similar to that of a condition slightly more general than ordinal potential, without considering a third relation (a possible potential). It is apparent that the exploration was incomplete and demands further examination. In this report, two definitions of "general" are mentioned and a third relation is taken into consideration. The program returns one condition that characterizes all games with PNE in a 2-by-2 case. In the second definition of "general", a more thorough exploration is executed but produces nothing substantial.

Google Android Platform and Application Development

Advisor: *MUPPALA K R Jogesh / CSE*
Student: *CHU Chun Yin / COGBM*
(UROP Courses: UROP1100, Fall 2012;
UROP1200, Spring 2013)
TSE Kit Yam / COMP
(UROP Courses: UROP1100, Fall 2012;
UROP1200, Spring 2013)

Android is an open source smart-phone operating system published by Google, and one of the dominating platforms in the smart-phone market. In the previous semester, our team implemented two interactive user interface prototypes for the Medecins Sans Frontieres Android mobile application. This semester, we integrate these two interfaces into a single package, optimize the UIs for different display dimensions and test and debug the application.

An Evaluation Framework for Search Engine Personalization

Advisor: *NG Wilfred S H / CSE*
Student: *WANG Heng / COMP*
(UROP Course: UROP1300, Fall 2012)

Search engine personalization has been a hot topic in recent years, and the objective of this project is to build an evaluation framework to be used in other projects involving personalization. However, because relevance and personalization are both complex multi-dimensional concepts, it is difficult to evaluate the effectiveness of personalization. This report summarizes the different components of this project; that is, query long mining, query reformulation, query prediction and mobile application search. We note the challenges and the specific difficulties of the original setting for this project. Finally, we introduce an evaluation framework used by other researchers that shows how the evaluation for personalization works when the necessary conditions are satisfied.

Data Mining RFID Data

Advisor: *NG Wilfred S H / CSE*
Student: *LI Tao / CS*
(UROP Course: UROP1100, Fall 2012)

We develop an algorithm to solve the problem of uniformly sampling a *k* maximal frequent trajectory. First, the algorithm for mining the *k*-UMF trajectory is introduced and the related experiments are explained. We use an empirical comparison of the MCMC-based algorithm and PrefixSpan, which is the traditional algorithm for mining the *k*-UMF trajectory, to show that our algorithm is much faster, with reasonable quality loss.

Advisor: *NG Wilfred S H / CSE*
Student: *ZHANG Zhijun / CS*
(UROP Course: UROP1300, Fall 2012)

In this project, we introduce classification techniques for RFID noise identification. Because the traditional classification cannot support RFID scenarios in which negative labeled data are difficult to acquire, we modify the traditional classification techniques to satisfy our needs. Experiments have been conducted on our method and they have proven that it works quite well. We have also tested the parameters in the algorithm provided and recommend their values, in addition to developing a demonstration application for RFID professions to apply our method.

Improving Searches in Emerging Domains: Twitter Search Personalization and Semantic App Search

Advisor: *NG Wilfred S H / CSE*
Student: *HAO Xiaotian / PHYS-PP*
(UROP Course: UROP1100, Spring 2013)

Given the tremendous number of apps being developed, an effective scheme is needed to guide users in finding the most relevant and outstanding examples. In this project, I design a framework, developer-inspector that collects data from multiple information sources to provide an objective evaluation and generate profiles for the developers. Based on the profiles, two new applications are proposed to facilitate application searches and development outsourcing. The majority of search results can be confirmed using these two applications to establish the developers' reputations. In this project, I design the UI, achieve the search engine functions, manually label application comparisons and prepare queries for experiments, among other tasks.

Mining Crowdsourced Knowledge on Social Media

Advisor: *NG Wilfred S H / CSE*
Student: *CHEN Weikeng / COMP*
(UROP Course: UROP1000, Summer 2013)

One of the most important functions of the social networks is photo sharing. Photos could often explain more details than words, and also they can be uploaded and shared more easily than videos. Almost all social networks provide the photo sharing function and it is considered as the major feature of many of them.

In this project, we analyze two similar photo-sharing-based social networks: Instagram and Flickr, which are both driven by a large number of photos from users all over the world. By comparing their characteristics of their users, operating models, number of photos and tags, we obtain the way they served the users. Also by comparing the features of these social networks, we can do relevant outsourcing from them.

Keywords – Online Social Networks, Photo Sharing, Graphs, Crowdsourcing

Advisor: *NG Wilfred S H / CSE*
Student: *WANG Xinyu / CPEG*
(UROP Course: UROP1000, Summer 2013)

Team formulation in social networks is an important problem in many applications based on crowd-selection over social graphs. While this problem is non-deterministic polynomial-time hard (NP-hard), in recent years, many algorithms have been proposed to solve it in a reasonable time for real datasets. However, because they have not been empirically compared to one another in most research work, it is unclear whether the later work outperforms the earlier. Another problem is that the reported comparisons were often done using different datasets. In this project, we first address these serious problems by re-implementing five state-of-the-art team formulation algorithms in a common code base and comparing them using many real-world datasets and query tasks. Based on our in-depth analysis of the experimental results, we then report surprising empirical findings. Finally, we provide a common baseline platform to further study the problem of team formulation in social networks.

Mining Geographical Interests of Twitter Users

Advisor: *NG Wilfred S H / CSE*
Student: *GONDOPRASTOWO Ivan / COMP*
(UROP Course: UROP1200, Fall 2012)

We study the possibility of leveraging Twitter use as a source of information to create a tool that helps users personalize their web search results. The current commonly-used implementation of personalized web searches is based on previous clicks and page tracking. We implement a prototype that realizes a novel way to personalize users' web search results by profiling Twitter use; that is, which Twitter accounts users follow, users' retweets and favorites and the topics most often found in users' tweets. We also observe the growing trends of smartphone adoption, which has prompted the need for a usable search application that incorporates a novel way to search personalization, filtering and recommendations.

Mining on Uncertain and Large Scale Data

Advisor: *NG Wilfred S H / CSE*
Student: *LI Tao / COMP*
(UROP Course: UROP1100, Summer 2013)

Stream data clustering is an increasingly important task in the field of data analysis and management because the development of technology such as sensors and the Internet produces a significant amount of stream data. Compared to traditional clustering problems, the data stream clustering problem is considerably more difficult, as stream data is assumed to be infinite and thus cannot fit into the memory. This makes it expensive to perform random accessing of data, such that a stream data clustering algorithm must be 'one pass'. Many of the algorithms proposed to solve this problem exhibit reasonable time and memory space consumption. However, there has been limited formal comparison of the different methods that share the same environment and standards. In this project, we provide a detailed comparison and in-depth analysis of the different methods and discuss the tradeoffs between their quality and their use of space and time.

Probabilistic Database Normalization

Advisor: *NG Wilfred S H / CSE*
Student: *ZHAO Jing / COMP*
(UROP Course: UROP1000, Summer 2013)

Uncertain data are inherent in a few important applications, such as environmental surveillance and mobile object tracking. As a result, various probabilistic database management systems have been developed to support the storage and querying of these uncertain data. One major task is to check functional dependencies, given a probabilistic database. In this project, we first clarify the definition of probability of failure on demand (PFD) based on the indeterministic nature of probabilistic database systems, and show related concepts such as possible worlds and possible world space formed under these circumstances. Then we propose a method for systematically checking PFD. After an empirical study of both real and synthetic data, we improve the method to make it more sensible and feasible by introducing the idea of core set tuples.

Keywords **–** probabilistic database, functional dependency, U-Popk ranking

Visual Analysis of Financial News Articles

Advisor: *QU Huamin / CSE*
Student: *DAI Zuozhuo / CSIE*
(UROP Course: UROP1200, Fall 2012)
LI Ligeng / COMP
(UROP Course: UROP1200, Fall 2012)

In this project, we design a visualization tool for representing the geographic names in financial news articles to directly show the scope of business and its trend for big companies. First, all of the geographic names (names of cities and countries) are selected from a vast number of news articles related to a certain company. Then, a pie chart, a line chart and a map with circles marking those geographic names are drawn based on the data gathered in the first step.

Advisor: *QU Huamin / CSE*
Student: *NG Yik Wai / COGBM*
(UROP Course: UROP1000, Summer 2013)

Although many current visualization approaches to time series data do show a good general trend of topic or theme over time, we require a deeper understanding of the issues. We may get a big picture in which key issues arise and disappear over time, but it does not clarify the specific relationships of interest. In financial and economic news, we can adopt similar techniques to visualize the changes in topics or trends over time, but we sometimes are more interested in how financial or economic performance indicators interplay or change over time. With a set of well-defined and commonly used equations or indicators in the field of Economics and Finance, we can refine our visualization by tracking these variables. In this project, we make use of the line plot layout to track these indicators and leverage the word cloud to reveal how these indicators are affected by the changes in social and economic environments.

Keywords –Financial News Visualization, Trend Focus, Domain Knowledge Visualization

Efficient Algorithms for Mining Biological Datasets on Modern Graphics Processing Units (GPUs)

Advisor: *SANDER Pedro V / CSE*
Co-advisor: *HUANG Xuhui / CHEM*
Student: *LAW Hei / COMP*
(UROP Course: UROP1000, Summer 2013)

We are trying to design a parallel algorithm that would reorder the triangles in a mesh, enabling the graphic processing unit to process the vertices and pixels more efficiently. The idea is based on the article “Triangle Order Optimization for Graphics Hardware Computation Culling” by D. Nehab, J. Barczak and P. Sander (2006). We are trying to modify the algorithm described in the article to make use of the graphic processing unit’s tremendous computing power to quickly reorder the triangles in a mesh.

Keywords – Parallel Algorithm, Cache Optimization

Efficient Algorithms to Process Gigapixel Images

Advisor: *SANDER Pedro V / CSE*
Student: *KHARBANDA Sunena / SENG*
(UROP Course: UROP1000, Summer 2013)
MAHESHWARI Praveg / SENG
(UROP Course: UROP1000, Summer 2013)

Images help people keep their memories alive, and the invention and development of smart phones has resulted in a camera in every phone. There are more than a thousand image editing apps and software available to smart phones and computers that allow the user to crop, resize and scale images, along with the global removal of pixels. The diversity and versatility of display devices imposes new demands on digital media, but in addressing these demands have we ever considered that using these methods actually decreases the quality of our images by significantly reducing their width? Seam carving is another way to maintain the quality of an image while still efficiently reducing its size. It even works for sizes of a million pixels, giving you full images while efficiently removing a low energy path.

Advisor: *SANDER Pedro V / CSE*
Student: *KHURANA Vibhor / COMP*
(UROP Course: UROP1000, Summer 2013)

In this project, techniques are proposed for correcting the geometric distortion in gigapixel images caused by atmospheric turbulence. Two algorithms are suggested to remove the geometric distortion using a set of images to produce a high quality image and restore the sharpness of the original images. One method deals with computing an approximation of the gradient of the image intensity function using a Sobel operator. The other method maps the pixels of an image onto a new grid, compares it with the other images in the set, and then produces a new image using bilinear interpolation. These methods could be applied to the individual images of a panorama to produce a gigapixel image without geometric distortion or a loss of sharpness.

Keywords **–** Gigapixel Images; Sobel Operator; Bilinear Interpolation; Atmospheric Turbulence

Advisor: *SANDER Pedro V / CSE*
Student: *WU Sisi / PHYS-PP*
(UROP Course: UROP1000, Summer 2013)

This project explores efficient methods for generating and processing large images with tens of billions of pixels including stitching photographs into panoramas, displaying the images efficiently, mapping the images to 3D models and matching multiple images for compositing. I design a user interface that provides a better display of the gigapixel and processed images. The user interface makes good use of a technology named Seadragon, developed by Microsoft. The DeepZoom technology is also introduced, and combining these two applications, the large pixels images such as panoramas can achieve web-optimized visualization. The comparison also extends among the original gigapixel images, the retargeting images and the standard scaling images.

Efficient Queries over Database

Advisor: *WONG Raymond C W / CSE*
Student: *XIE Min / COMP*
(UROP Course: UROP1100, Summer 2013)

The wide use of location-tracking sensors has given rise to an abundance of data that are in the form of trajectories. One of the core problems in trajectory analytical tasks is developing a mechanism to compute the spatio-temporal similarity between two trajectories. In this project, we study a variety of distance functions that are used to measure the similarity of two trajectories, e.g. edit distance with projection (EDwP), edit distance with real penalty (ERP), edit distance on real sequence (EDR), dynamic time warping (DTW), longest common subsequences (LCSS) and dissimilarity (DISSIM). We define each distance function and introduce its pruning technique and indexing structure, if any.

Keywords **–** Trajectory Similarity, Distance Function, Pruning, Indexing

Efficient Queries over Spatial Databases

Advisor: *WONG Raymond C W / CSE*
Student: *LU Shubang / CPEG*
(UROP Course: UROP1100, Fall 2012)

As electronic maps become increasingly popular, efficient queries over special databases are in high demand, especially for large-scale databases. Traditional special databases and map systems focus on queries over two-dimensional (2D) space and there are many algorithms and methods for finding the shortest path between two locations inside a 2D plane. However, new demands have emerged, as this technology and its applications develop quickly. One such demand is efficient queries over three-dimensional (3D) special databases. The main objective of our project is to develop an efficient method for finding the shortest path between two locations inside a 3D plane. I review the research on related algorithms and try to construct a solution by applying the existing algorithms.

Knowledge Discovery over Database

Advisor: *WONG Raymond C W / CSE*
Student: *CHEN Anhua / SBM*
(UROP Course: UROP1000, Summer 2013)

The booming popularity of social networks (e.g. Facebook, Weibo, etc.) has prompted intense study of the models simulating the diffusion of influence and the learning behavior among individuals over social networks. Among such studies, the DeGroot model is a widely known dynamic describing a naïve non-Bayesian learning process.

In this project, we examine an extension to the DeGroot model called the Memory DeGroot model in which a memory feature is captured into the DeGroot model, which addresses not only the latest influence updating matrix, but also a forgetful sequence of historical updating matrices.

We also study both the single-player and competitive influence maximization problems under our memory DeGroot model to determine how to maximize the number of influenced nodes by seeding a limited number with constraint budgets before the diffusion begins. Due to the convergent feature of our Memory DeGroot model, it is possible to find an optimal solution to both the single-player influence maximization problem and the competitive influence maximization problem.

Advisor: *WONG Raymond C W / CSE*
Student: *WANG Xiaofang / COMP*
(UROP Course: UROP1000, Summer 2013)

This project focuses on the moving objects database. I learn several types of structures that can be used in different conditions and for different purposes. The author provides efficient algorithms for use in the newly created data structures, some of which are based on the previous work, giving me the opportunity to review the related literature. For example, the loose quadtree is based on the FX-CIF quadtree, which may have some problems in modeling the real data. There are also experimental evaluations that help me improve my research skills.

Implicit Crowdsourcing

Advisor: *YEUNG Dit Yan / CSE*
Student: *LEE Min Hyung / COSC*
(UROP Course: UROP1100, Summer 2013)

Crowdsourcing platforms are increasingly being used to label large datasets, which are used as training data for various machine learning models. Although these platforms take less time and money in creating labels compared to hiring experts, the quality of the labels is impaired. High variance in labeling experience in the field leads to labels of different quality. Thus, measures that could effectively filter out low-quality labels and return good-quality labels are necessary. Since the introduction of crowdsourcing platforms in the context of labeling, many researchers have proposed various methods using different approaches to the problem. We compare these methodologies, analyzing their strengths and weakness, and note issues that remain unanswered and are open for further research.

Department of Electronic and Computer Engineering

3DTV

Advisor: *AU Oscar C L / ECE*
Student: *FAN Xinzhi / SENG*
(UROP Course: UROP1000, Summer 2013)

Three-dimensional television (3DTV) development is considered a promising research direction. In this project, we explore three aspects: the basic concept of digital image processing, a survey of 3DTV (especially 3DTV compression and transmission) and image morphing. These three aspects, presented from shallow to deep, respectively, provide an overall understanding of digital image processing and 3DTV. Meanwhile, the project looked deep into a specific aspect related to 3DTV, studying some of the research achievements of this area and realizing some of the related algorithms in the area of image processing and morphing using MATLAB.

Keywords—digital image; image processing; 3DTV; image morphing

Advisor: *AU Oscar C L / ECE*
Student: *SHUM Ho Kiu / SENG*
(UROP Course: UROP1000, Summer 2013)

This project involved familiarizing ourselves with the idea of depth-image-based rendering (DIBR), a new approach to 3DTV, by reading and implementing program code.

Advisor: *AU Oscar C L / ECE*
Student: *ZENG Cancheng / SENG*
(UROP Course: UROP1000, Summer 2013)

Image inpainting is a special image interpolation problem that often refers to interpolations over large-scale missing domains. There have been two types of methods to address the problem: PDE-based and exemplar-based inpainting. The former can recover the textures and linear structures but is not good at handling curved structures and the regions where similar regions do not exist, while the latter can effectively recover the topology of the region to be filled but cannot synthesize texture and has a blurred effect. This project contributes to the development of the computational efficiency and inpainting effectiveness of the two algorithms. The combination of the two algorithms to acquire both methods' advantages is also discussed.

Next-Generation Video Coding

Advisor: *AU Oscar C L / ECE*
Student: *MOU Qingqi / ELEC-EP*
(UROP Course: UROP1000, Summer 2013)

Two international standard bodies, ISO/IEC MPEG and ITU-T VCEG, are jointly developing the next generation video compression standard. HKUST is involved in this exciting and highly competitive standardization work. My involvement in this project has centered on image processing technology, which is the basis of video processing and has been the main focus of the project, including basic techniques such as white balance, histogram equalization and image recognition. Moreover, a segment of video coding relevant to compression and high resolution coding is partially covered. Although the period is short, the research has been tremendously fruitful and helpful to further work. This report describes the overall progress and provides suggestsions for implementation.

Keywords – Image Processing, Video Coding

Advisor: *AU Oscar C L / ECE*
Student: *XING Fangzhou / CPEG*
(UROP Course: UROP1100, Summer 2013)

In this project, I researched and implemented an auto white balance algorithm using two different assumptions, a histogram equalization algorithm with back projection. I also familiarized myself with the basic method used in video coding.

Social Network Multimedia Research

Advisor: *AU Oscar C L / ECE*
Student: *HONG Ruiliang / ELEC*
(UROP Courses: UROP1100, Fall 2012;
UROP1200, Spring 2013)

In this project, I continued the research I conducted last semester on image processing and high dynamic range (HDR) in which I learned the basic concepts of HDR image construction. This semester, I have learned tone mapping and HDR imaging in addition to gathering more basic knowledge of image processing (e.g., what is an image, what is a pixel, how to represent an image/pixel, what is resolution, what is color space for the image, what is RGB/YUV color space, how are RGB and YUV related, etc.). I have also improved my MATLAB programming skills, which is important in understanding the codes used in the method.

Nano-Transistor Design and Simulation

Advisor: *CHAN Man Sun / ECE*
Student: *PRAWOTO Clarissa Cyrilla / CPEG-HR*
(UROP Course: UROP1300, Fall 2012)

The lateral misalignment of the gate of a Fin-FET causes channel thickness non-uniformity, such that the thickness increases gradually along the channel. The increase in overall thickness affects the performance parameters that indicate short channel effects, such as I_{on} and I_{off}. In this project, how increasing channel thickness and non-uniformity affect short channel effects is studied by simulating two-dimensional DG-MOSFET structures. Increasing thickness along the channel results in a worse leakage of current, but compared to the uniform thickness structure with the same average thickness, the one with non-uniformity has less current leakage and better short channel performance.

Nanomaterial-based Novel Solar Cells

Advisor: *FAN Zhiyong / ECE*
Student: *DUAN Xicheng / ELEC-HR*
(UROP Course: UROP1100, Fall 2012)

In photovoltaic devices such as solar cells, light trapping efficiency critically determines performance. In this project, several types of three-dimensional nano-structures are applied to realize high optical absorption. Nano-pillars (NPLs), Nano-wells (NWLs) and a combination of these two structures are studied to understand the potentials and limits of each kind of structure. The structures are fabricated on Al foils according to the concept of a self-organized approach, which can greatly reduce fabrication costs. Once the Al structures are constructed, thin films of light absorbing material are deposited on them to measure their performance and features. The novel structure combining NPLs and NWLs shows the most promising photon trapping potential.

Advisor: *FAN Zhiyong / ECE*
Student: *LI Xiang / CPEG-HR*
(UROP Courses: UROP1100, Spring 2013;
UROP1000, Summer 2013)

Supercapacitors are made from nano-materials with very complex nano-structures that can substantially increase the effective area of the electrode, thus increasing the contact area between the electrolyte and the electrode. This results in a considerable increase in the capacity and power density of the supercapacitor. The fabrication of the nano-structure for a supercapacitor is similar to that for the structure of a solar cell, thus in this project we can use the nano-structures we already have and incorporate them into the supercapacitor. We then combine the supercapacitor with the solar cell to construct a power unit that is capable of converting solar energy into electrical energy, and storing the electrical energy inside the supercapacitor.

Keywords – supercapacitor, nano-structure, effective area

Advisor: *FAN Zhiyong / ECE*
Student: *SEITH Gursimran Singh / SENG*
(UROP Course: UROP1000, Summer 2013)
TRIPATHI Siddhant / SENG
(UROP Course: UROP1000, Summer 2013)

In this project, we not only had the opportunity to work on solar cells, but also to simulate electric fields for applications such as electroporation. We focused on the electric fields generated by aluminum nano-spikes by generating the aforementioned nano-spikes in the laboratory. We also describe our individual contributions and efforts along with those of our advisor and his postgraduate students.

Advisor: *FAN Zhiyong / ECE*
Student: *TANG Haoning / ELEC*
(UROP Course: UROP1100, Summer 2013)

This project involved research and experiments on the nano solar water splitting cell. The water splitting device is briefly described, followed by the information realized on photoelectrochemical (PEC) cells thus far. The experiment conducted with the photoanode using the PEC water splitting device and the current performance of different types of Fe_2O_3 photoanodes are concluded and plans for future study are preseted.

Keywords—water splitting device; photoelectrochemical (PEC) cells; Fe_2O_3 photoanode

Semiconductor Nanowire-based Sensors and Electronics

Advisor: *FAN Zhiyong / ECE*
Student: *CHEN Zhuo / SENG*
(UROP Course: UROP1000, Summer 2013)
WU Tianhe / ELEC
(UROP Course: UROP1000, Summer 2013)

The fabrication of three-dimensional nano-structures has been widely used in the application of nano-scale devices; specifically, structures such as nano-wires, nano-pillars and nano-cones that have considerable light-trapping features and thus have earned much attention in terms of serving as templates for thin-film solar cells. In Fan's Lab, we use porous anodic aluminum membranes (AAMs) formed by a self-organized mechanism as templates for a-Si solar cells. We control the anodization and etching time to fabricate different nano-structures of various pitches and aspect ratios (pore depth divided by pore size). We also investigate the possibility of using polyimide (PI) as a flexible template for solar cell fabrication by either peeling off solidified PI from nano-structured AAM or sputtering aluminum on PI and modifying the surface.

Keywords – template; 3D nano-structures; AAM; polyimide

Pose Control of a Quadrotor

Advisor: *LI Zexiang / ECE*
Student: *JIN Hongyi / ELEC*
(UROP Course: UROP1100, Spring 2013)

In this project, a method for accomplishing human recognition and tracking via a quad-copter is explored in a condition of a stable background between adjacent sampled pictures. It is realized by digital image processing and a simple machine learning method. For each received video, each picture is sampled and digital image processing is used to obtain binary images that contain the tracked object and background. Assuming that the backgrounds of two adjacent sampled pictures are unchanged, an object's movement can be detected by differentiating these two pictures after eliminating noise. Then, an assumed moving momentum (a property in machine learning) and the location of a human face can be determined. Later, the recognition can be realized through semi-supervised learning. This method also offers a solution for the automatic initial selection of TLD Predator's bounding box, which determines the object's location in the picture.

Principles and Mobile Apps Development of Two-dimensional Bar Codes

Advisor: *MOW Wai Ho / ECE*
Student: *FUNG Sze Yuen / CPEG*
(UROP Course: UROP1100, Spring 2013)

Barcode payments and coupons have prompted numerous popular applications. Passbook and Alipay are successful barcode payment applications. In this project, I review the concept of and related technologies behind barcode payment systems. I compare RFID and barcode payment systems using the Alipay and Octopus payment applications as examples. In addition to the general online barcode payment system, barcode offline payment systems are suggested.

Advisor: *MOW Wai Ho / ECE*
Student: *LIU Zhen / ELEC-HR*
(UROP Course: UROP1100, Summer 2013)

Two-dimensional (2D) barcodes are becoming increasingly popular. As a way of conveying information, a 2D barcode can be used not only for tracking and identifying goods but also for advertisements. The application prospects of 2D barcodes are very promising, as more people have smart phones and almost all the smart phones today can be used as a 2D barcode decoder based on the camera and some simple application software.

In this project, professor Mow is developing a new kind of 2D barcode called a Pi-Code. To improve the advertisement effect, companies are trying to embed their logo in the 2D barcode. However, due to the limitations of error correction capability, the logo can only occupy a tiny area at the center of the barcode, which requires many companies to use a reduced version of their logo. In the Pi-Code, the entire logo is embedded as the background.

The compatible decoding program has been developed for the Pi-Code, and I am tasked with improving its detection and decoding performance. In this project report, I describe my method for shortening the decoding time through deblur. Because decoding failure occurs when the image is blurred, a proper deblur program can help increase the decoding success rate and thus shorten the decoding time.

Advisor: *MOW Wai Ho / ECE*
Student: *LUO Yinting / ELEC*
(UROP Course: UROP1000, Summer 2013)

sRGB is a device-dependent color space that leads to the discrepancies of chromaticity representation across devices. In this project, color distortion in color models other than sRGB for devices such as PC screen displays and printers is examined. By studying other device-dependent color spaces we hope to find out whether it is possible to reduce the transmission errors of the sRGB model by adopting other models so that devices can make a robust choice of color space basis vectors when displaying images. The YUV color space is selected for illustration and experimentation. In this report, the main characteristics of some major color models and their correlations are delivered. Likewise, two experiments concerning color distortion in the display- and printer-camera channels are conducted.

Advisor: *MOW Wai Ho / ECE*
Student: *SETIAMANAH Ricky Dwiputra / CPEG*
(UROP Course: UROP1000, Summer 2013)

Barcode payment systems, although simple and favorable, can be risky when not coupled with a strong security measure. In this project, a feasible encryption method is discussed as a building block for a secure barcode payment system. Two main methods are examined: symmetric and asymmetric key algorithms. Moreover, specific encryption method modes are compared to acquire the best mode and achieve the safest encryption. We conclude that a 128-bit advanced encryption standard (AES) – which adopts the symmetric key algorithm – with cipher block chaining mode (CBC) is the encryption method that we will use.

Advisor: *MOW Wai Ho / ECE*
Student: *WIDJAJAMUKTI Ivan / ELEC*
(UROP Course: UROP1000, Summer 2013)

In this project, the minimum size requirement needed to store the critical features of fingerprints is determined. Minutiae-based fingerprint recognition is adopted due to its wide application in commercial fingerprint recognition systems and its reliability (over 90% accuracy is obtainable). This method extracts minutiae features (ridge ending and bifurcation) from a fingerprint image and stores them in a file, for further recognition purposes. The testing is performed using a MATLAB-based program to extract minutiae features from fingerprint images in three databases. To determine the minimum size requirement, the extracted feature files are further compressed and the size of the extracted feature and compressed files are then measured to draw the conclusion.

Advisor: *MOW Wai Ho/ ECE*
Student: *ZHANG Xinzi / ELEC*
(UROP Course: UROP1000, Summer 2013)

In this project, I studied different coding schemes such as RS, convolutional, Turbo and LDPC codes. I then repeated the experiments from the ELEC 4150 project, which was designed to identify the relationship between the block error rate (BLER) and the brightness (in lux) under different sets of configurations (angle, area and distance) using repeated experiments under the same conditions.

Advisor: *MOW Wai Ho / ECE*
Student: *ZHAO Chenze / ELEC-HR*
(UROP Course: UROP1000, Summer 2013)

The use of bar codes and QR codes has become more and more popular. However, the existing bar code system can only provide very limited visible information, and thus makes not a suitable choice for both promotion and recognition. In this project, we propose a two-dimensional bar code which can be embedded a picture, making it more recognizable and user-friendly. I was responsible for the development of an iOS app for the two-dimensional bar code. I have learnt the basic programming skills for development in iOS and the ways of using the C++ library in Objective-C. Based on an iOS app for the traditional QR code, I made some modifications and so it shares a similar user interface with an Android app.

Optical Tweezers using a Few-mode Fiber for Microparticle Trapping, Sizing and Sorting

Advisor: *POON Andrew W O / ECE*
Student: *YIU Kin Tat / PHYS*
(UROP Course: UROP1000, Summer 2013)

In this project, we demonstrate different array pattern generation using a two-dimensional multimode interference waveguide. The important component is a 100 μm square-core silicon waveguide with mm length. The waveguide mode fields are at the 1550 nm wavelength. We conduct the experiment with both single mode and lens fibers, demonstrating pattern generation using a few-mode fiber with a 1064 nm laser input, which has a 10 W power output limit. Different patterns were generated by this relatively simple setup through adding a gold-coated glass at a suitable tilting angle. The primary simulation was designed to analyze the pattern generated in the experiment.

Keywords – multimode interference waveguide, few-mode fiber, pattern generation, optical tweezers

Magnetic Levitation Systems and Their Control

Advisor: *QIU Li / ECE*
Student: *YIN Chenxi / ELEC-HR*
(UROP Course: UROP1100, Spring 2013)

The purpose of this project is to update a magnetic levitation system with a new positioning strategy. The original strategy is achieved by visible light and a receiver, while the proposed one is to implement a self-sensing via modulation approach. This approach adds a high frequency signal to the control signal and extracts the position information by demodulation. The current magnetic levitation system is studied and modeled accordingly in MATLAB Simulink. Software simulations are conducted and the new approach is proved to pay off temporarily. Future work will focus on hardware-in-the-loop simulation to yield a final analysis of the strategy's practical functionality and feasibility.

Keywords – magnetic levitation; self-sensing; DSP

Cloud-assisted Social Network Analysis in Weibo

Advisor: *SHE James / ECE*
Student: *YU Fan / CPEG*
(UROP Course: UROP1000, Summer 2013)

Microblog (Weibo) is a platform based on users' relationships that allows users to share, spread and obtain information within small elements of content. A piece of programming was compiled to collect data from users of the Sina Weibo Development Platform. Data collection was performed in the cloud-based databases of Cyberport, Hong Kong, to achieve constant collection from Sina Weibo. Images collected from users' statuses were used to analyze the social networking of Chinese people in Sina Weibo, using the bag-of-feathers visual recognition model. The project has not yet achieved massive image collection from Sina Weibo.

Keywords – Sina Weibo, cloud-based database, Bag-of-Feather model, images recognition, social network.

Smart Cushion

Advisor: *SHE James / ECE*
Student: *WU Tongshuang / SENG*
(UROP Course: UROP1000, Summer 2013)

The insertion of digital displays in physical items to improve their fashion level is an emerging trend. “Smart clothing” can change pattern according to different conditions by integrating a piece of cloth or an accessory with an LED system that can communicate with a smartphone. However, each system is highly unified for every consumer and serves only one user without being sharable. This project is proposed to improve the system supporting the online sharing and personalization of such items. The new era cushion maintains a nice appearance in addition to its functionality, interactivity and comfort. The system has been successfully tested.

Keywords – cyber-physical system, cushion, smartphone, Smart Clothing, LED Matrix

A Learning Based Analytical Model for Network-on-Chips (NoC) Performance Evaluation

Advisor: *TSUI Chi Ying / ECE*
Co-advisor: *QIAN Zhiliang / ECE*
Student: *ZHAO Yuelin / ELEC*
(UROP Course: UROP1100, Spring 2013)

Network-on-chip (NoC) has been proposed as a promising alternative to bus-based chip designs. One of the challenges is to explore and evaluate different topologies and interconnections. Compared with conventional analytical performance evaluation models, which are based on the queuing theory and whose accuracy and predicting speed is far from satisfactory, models based on machine learning techniques are far more accurate and efficient. We compare different latency models based on different machine learning algorithms including least squares support vector machine, ensemble learning and artificial neural network. The model accuracies are demonstrated using a different test data set and then compared with the accuracy of conventional queuing models.

Artificial Intelligence for Games

Advisor: *WONG Albert / ECE*
Co-advisor: *WOO Kam Tim / ECE*
Co-advisor: *LEA Chin-Tau / ECE*
Student: *FAN Tsz Hong / CPEG*
(UROP Course: UROP1000, Summer 2013)
MA Ho Shun / CPEG
(UROP Course: UROP1000, Summer 2013)

Motion sensing games are the trendiest area in electronic gaming. They provide a brand new gaming experience to users and thus are in high demand. Kinect, which uses a camera that can capture users' motion, provides a foundation for motion sensing. Studying how Kinect reacts and processes the image it receives is necessary. The simplest and most convenient way is to combine Kinect, a motion sensing camera and a game engine called Unity3D. By using Kinect and Unity3D together, we can recognize users' skeletons and match them with objects in Unity3D.

Natural Dyes as Photosensitizers in Dye-sensitized Solar Cells

Advisor: *WONG Man / ECE*
Student: *JOUNG Youngkwang / CHEM*
(UROP Course: UROP1100, Summer 2013)

Fossil fuels have remained the most reliable source of energy until recently. Yet, the fact that this non-renewable energy source will be exhausted within a few decades has prompted many researchers to turn their attention to renewable energy, especially solar energy. Dye-sensitized solar cells (DSSCs) made from relatively low-cost materials have shown huge potential as alternatives to non-renewable energy sources. Although the difficulty of finding a sensitizer that is highly efficient but low cost has postponed the commercialization of DSSCs, researchers expect it to be one of the major and applicable energy sources in the coming years. In this project, different types of dyes such as ruthenium complexes, porphyrin-based sensitizers, organic dyes, natural dyes and various co-sensitizers are carefully reviewed and future challenges to the academic research on DSSCs are discussed.

Research on Different Kinds of Thrusters for Underwater Robotics

Advisor: *WOO Kam Tim / ECE*
Student: *CHEUNG Ho Kai / ELEC*
(UROP Course: UROP1000, Summer 2013)

The goal of this project is to find a new way to implement thrusters for underwater robotics. The traditional electrical thruster (electrical motor with propeller) can cause serious heat problems within the motor driver when it draws a lot of current. A new type of thruster is needed, one that is powered by another power source. This research is part of a group project in which a pneumatic-powered thruster has been proposed. The efficiency, thrust weight ratio and effectiveness of the new thruster are studied here.

Advisor: *WOO Kam Tim / ECE*
Student: *CHUNG Ching Chun / MECH*
(UROP Course: UROP1000, Summer 2013)

The 2013 Marine Advanced Technology Education International Competition revealed that the thrusters occupied most of the space in our remotely operated vehicle (ROV). This was the main reason for the vastness of our ROV. The thrusters are commonly used to drive speedboats, and thus have a heavy loading that can draw enough current to burn all of the motor drivers. High-frequency pulse-width modulation (PWM) cannot be used to drive the motors, as the sudden rise can also overheat the motor drivers. We must maintain it at a low frequency and a low duty cycle (18%, for example). We can solve this problem by adopting SeaBotix thrusters – well-waterproofed thrusters that are popular among the ROV community. However, they cost around US$600 to US$900 each (refer to http://www.homebuiltrovs.com/rovforum/viewtopic.php?f=3&t=1084), which is beyond our budget. I happened to read an article about hydraulic system implementation on a ship (URL:http://www.jpcdirect.com/wp-content/uploads/2010/05/HYD2009_web.pdf) that compares electric and hydraulic thruster systems. However, this system uses oil as the hydraulic fluid and propeller blades instead of hoses to move the ship. I was inspired by this system and began to wonder if I could use water instead of oil and hoses instead of propeller blades to build an innovative thruster system underwater robotics. It would allow me to save costs by buying individual waterproof DC motors, as hydraulic components can be cheaper than waterproof DC motors.

My idea for the hydraulic thruster system is to pump water from a pool or ocean and transfer the kinetic energy of the water to the ROV. The concept is similar to the small booster on satellites that only activates when it needs to fine-adjust its position. The outlets are hoses that are all securely tied on the frame, so directional control can be achieved. It would be a brand new technology if it becomes mature.

Advisor: *WOO Kam Tim / ECE*
Student: *IM Zhuo Quan / PHYS-PP*
(UROP Course: UROP1000, Summer 2013)

In underwater robotics, thrusters provide mobility, and making them waterproof is the essential challenge. The aim of this project is to manufacture and test an underwater thruster using a different approach to overcome the waterproofing problem.

Building a Servo Robot with Vision Control

Advisor: *WOO Kam Tim / ECE*
Student: *WIDY Andreas / ELEC*
(UROP Course: UROP1000, Summer 2013)

In this project, a servo robot is built and operated via vision control. Eight MG995 servos are used to construct the mechanical arm of a humanoid robot. As a commercially available product, the Kinnect XBOX 360 is used as a sensor to provide images and distance measurements. Using libraries provided by an open-source prime sense, Kinect can track human skeletal objects and store the coordinates of several joints. Those coordinates are then transferred and processed on Arduino UNO, which is connected to the computer through serial communication. Using this method, one can control the robotic arm by moving his or her hand in front of the Kinect.

Robot Design Infrastructure

Advisor: *WOO Kam Tim / ECE*
Student: *CHENG Xuran / MECH*
(UROP Course: UROP1000, Summer 2013)

Brushless machines (BMs) are widely used in Robocon competitions. They have several advantages that the traditional motor with an electrical brush cannot match, such as high spindle speed and excellent efficiency. Hence, we aim to apply brushless machining in our robotics team. For Robocon, a BM's main function is to drive a propeller to generate driving force that can not only be used to provide motion to robots, but also to accelerate the game props. In this project, we develop the application of BMs and explore how to control their performance. Such control methods are divided into three parts: mechanical (assembly), hardware (cable connection) and software (how to use a pulse width modulation signal to control the BM). In addition, a simple comparison between two BMs is made for future reference.

Advisor: *WOO Kam Tim / ECE*
Student: *KIM Minsam / COGBM*
(UROP Course: UROP1000, Summer 2013)

Omni- and mecanum-wheels are frequently used in robot construction. Their omnidirectional capability is a desirable characteristic for handling complex tasks with multiple directional changes. This particular research is focused on algorithmic design for controlling such systems more efficiently and accurately. It has been discovered that mechanical settings may affect the algorithmic design in the later stages. The orientation of the vehicle's forward direction affects its later task completion capability. The angle of the wheels is another factor that should be determined carefully before installation. The primary objective of this project is to elaborate on two major types of interfaces. The input type of the first interface is the vehicle's motion, and the second interface receives the vehicle's ultimate destination as an input. Although the first interface expects human controllers to skillfully achieve accuracy and speed, the second interface relies solely on the system for accuracy and speed.

Scalable Nanofludic Electronic Devices for Biomolecular Analysis

Advisor: *YOBAS Levent / ECE*
Student: *ZHOU Shengke / MECH*
(UROP Course: UROP1000, Summer 2013)

Nanofluidic diodes are nano-fluidic devices that can rectify ionic current. Similar to a traditional electronic diode with low resistance to current flow in one direction, and high resistance in the other direction, the device can be used to control ionic current by introducing a positive or negative electric field. We demonstrate a novel nano-fluidic diode that rectifies ionic current using a nano-slit with asymmetric geometry. The rectification effect is demonstrated as a biased I-V curve under a voltage pulse sequence. The effect has broad chemical and biomedical applications such as the sensing or separation of certain molecules (e.g., nucleic acids).

Study of Three-dimensional Imaging Techniques

Advisor: *YUAN Jie / ECE*
Student: *CHEN Ran / ELEC-HR*
(UROP Course: UROP1000, Summer 2013)
LU Shuhao / MECH
(UROP Course: UROP1000, Summer 2013)

Laser scans are commonly used for three-dimensional (3D) surface profiling. This project pursues a cost-effective approach capable of generating the sufficient points cloud for 3D reconstruction. This approach is based on laser triangulation, which is a fundamental method of distance or depth measurement. Compared with precise radio detection, only an extra VGA camera and laser are needed for hardware. The accuracy of this setup for a static target in subdued light could reach a resolution of 5 *mm* within 1 *m*. Currently, these algorithms can be used to scan parts and reconstruct in 3D format. With continuous development, this technology may soon be applied in simultaneous localization and mapping (SLAM) and concurrent mapping and localization (CML).

Visible Light Data Acquisition System Design and Characterization

Advisor: *YUAN Jie / ECE*
Student : *WANG Yufeng / ELEC*
(UROP Course: UROP1000, Summer 2013)
XU Fang / CPEG
(UROP Course: UROP1000, Summer 2013)

Significant research is being conducted in visible light communication (VLC) – a promising technology with many advantages. There is a Visible Light Communications Consortium (VLCC) comprising many telecommunications and lighting companies determined to develop and commercialize VLC. The IEEE 802.15.7 Visible Light Communication Task Group has also completed a PHY and MAC standard for VLC. Keio University has achieved a 1 Gbps transmission rate using an LED array. It can be predicted that, in the near future, VLC will be widely applied in daily life.

To better understanding the VLC system, a simple VLC prototype is designed in this project and some tests are conducted to characterize the system. Ultimately, several suggestions for system improvement are also presented.

Department of Industrial Engineering and Logistics Management

Empirical Analysis of Electric Vehicle Infrastructure Development, Adoption and Usage Behavior

Advisor: *MAK Ho Yin / IELM*
Student: *JAIN Avni / CIEV*
(UROP Course: UROP1000, Summer 2013)
KONG Deyue / IELM
(UROP Course: UROP1000, Summer 2013)
SO Chung Kit / IELM
(UROP Course: UROP1000, Summer 2013)

The transportation sector is a major source of greenhouse gas emissions. As a step toward a greener environment, solutions involving electric vehicles (EVs) have been proposed and discussed. When powered by electricity from efficient and environmentally-friendly generators, EVs have significantly lower per-mile running costs compared to gasoline cars, while generating lower emissions. Unfortunately, due to the limited capacity of batteries, typical EVs can only travel for about 100 miles on a single charge. Thus, the huge challenge for adoption is to deploy a network of charging infrastructures to cover the needs of potential EV adopters. The long-term goal of this project is to develop an understanding of the relationships between charging infrastructure development, adoption and usage patterns for EVs by analyzing the latest industry data. We lay the framework for further study by collecting relevant data, formulating research hypotheses and performing some statistical analyses to gain a preliminary understanding of the trends in EV adoption and use. Analysis is mainly performed with the use of statistical software and geographical information systems (GISs).

Next Generation Enterprise Planning System

Advisor: *TSENG Mitchell M / IELM*
Student: *ARGEMI BALLBE Pere / IEEM*
(UROP Courses: UROP1100, Fall 2012;
UROP1200, Spring 2013)

This project investigated a Hong Kong apparel manufacturing company, combining a case study and research in the manufacturing engineering, supply chain and operations management field. The company needed to optimize its processes, with the main issue being the effects of variability. A literature review on variability and its effects was conducted to support the findings of the project and the development of a new approach that combines existing techniques, Bottleneck Analysis and Queuing Theory. Finally, the methodology was implemented and has influenced company performance.

Advisor: *TSENG Mitchell M / IELM*
Student: *LIU Yifang / IELM*
(UROP Course: UROP1100, Spring 2013)

This project was part of the New Inventory Management Approach Project, the main purpose of which was to discuss the necessity and importance of inventory. The topic could be regarded as innovative, as the reduction of inventory has long been a focus. The project and its related tasks are described.

Keywords **–** report; experience; conclusion; PowerPoint.

Department of Mechanical and Aerospace Engineering

Resuspension of Aerosols from Building Surfaces

Advisor: *CHAO Christopher Y H / MAE*
Student: *FONG Yick Sau / MECH*
(UROP Course: UROP1100, Fall 2012)
LEE Hau Him / MECH
(UROP Course: UROP1100, Fall 2012)

Liquid droplets such as salvia expelled through human coughing always attach to surfaces. Salvia droplets that contain infectious particles are a source of airborne infection if the droplets resuspend. This project studies the resuspension behavior of micrometer-sized artificial salvia droplets in the horizontal and vertical directions. The experiment is conducted by placing sample of artificial salvia droplets in a centrifuge to apply force in different directions. The result shows that the resuspension behavior in the horizontal and vertical directions differs; that is, the force required to resuspend an artificial salvia droplet in the horizontal direction is smaller than that required in the vertical direction.

Electrochemical Characterization and Evaluation of Thin Film Cathodes for Solid Oxide Fuel Cells

Advisor: *CIUCCI Francesco / MAE*
Student: *CHEN Wenhao / MECH*
(UROP Course: UROP1000, Summer 2013)

$SrCo_{0.9}Nb_{0.1}O_{3-\delta}$ (SNC) is an advanced and novel fuel cell cathode material whose properties have not yet been widely studied. In this project, the surface exchange and transport kinetics of the thin-film SNC grown on the single crystal $SrTiO_3$ (STO) substrate by pulsed laser deposition (PLD) is investigated. The oxygen vacancy (δ) was different when the sample was exposed to different oxygen partial pressures, and this change of the oxygen vacancy could lead to changes in electronic conductivity. Thus, the electronic conductivity of SNC is subject to change under various atmospheres.

The oxygen surface exchange coefficient k and bulk diffusion property D in SNC, along with their activation energy, have been determined by electrical conductivity relaxation (ECR) in this experiment. The result reveals that while the surface exchange coefficient k is confident, the bulk diffusion property D must be determined by another method.

Advisor: *CIUCCI Francesco / MAE*
Student: *DU Xiaohan / SENG*
(UROP Course: UROP1000, Summer 2013)

This project focuses on the characterization of thin film cathodes for SOFC. The main purpose of the electrochemical impedance spectroscopy (EIS) data is to find the best-fit model that illustrates the activation loss of the cathode reaction. We use EIS, which measures the impedance of thin film cathodes by applying a small sinusoidal oscillated voltage and then generates Nyquist plots, to evaluate the sample's performance under different temperatures (500-800°C) and oxygen partial pressures (pO2). The activation loss of $SrNb_{0.1}Co_{0.9}O_{3-\delta}$ (SNC) is visually shown to have a negative correlation with temperature and oxygen partial pressures. It also casts light on a new method of processing electrochemical data – the bootstrap. We aim to prove that EIS data is eligible to be processed under the parametric bootstrap by comparing their outcome with that of the experimental bootstrap.

Modeling Solar Thermal Fuel Generation

Advisor: *CIUCCI Francesco / MAE*
Student: *XIE Yuyang / MECH*
(UROP Course: UROP1100, Fall 2012)
ZENG Zezhi / MECH
(UROP Course: UROP1100, Fall 2012)

The amount of solar energy generated is excessive compared with present-day human consumption. The effective conversion of this renewable intermittent resource into a chemical fuel offers a sustainable energy future. The efficiency of conversion, however, may be relatively low. In this project, a model of electrocatalysis in a representative reactor is developed. It features oxygen, hydrogen and water transport in the gas phase, along with diffusion in the solid phase and surface kinetics. An understanding of how the gases diffuse in the porous reactor will be a great contribution to controlling the reaction to maximize efficiency. The finite element method is therefore introduced to approximate the model and determine the concentration of gases in different reactor locations.

Advisor: *CIUCCI Francesco / MAE*
Student: *XIE Yuyang / MECH*
(UROP Course: UROP1200, Spring 2013)

The abundance of solar energy provides a good opportunity for solving the world's energy shortages. The effective conversion of this renewable intermittent resource into a chemical fuel offers a sustainable energy future. Yet, the energy conversion is still relatively low, and further research is required. In this project, a solar cell model of a spherical reactor is developed. It features oxygen, hydrogen and water transport in the gas phase and oxygen ion diffusion in the solid phase. An understanding of how the gases diffuse in the porous reactor and then react within a solid substance will be a great contribution to controlling the reaction and maximizing efficiency. The finite element method is therefore introduced to approximate the model and could reveal the concentration of gases in different reactor locations.

Solid-State Supercapacitor

Advisor: *HUANG Baoling / MAE*
Student: *IP Tsz Yeung / MECH*
(UROP Course: UROP1100, Fall 2012)
LYE Wilson Wei King / MECH
(UROP Course: UROP1100, Fall 2012)
SUEN Hoi Lun / MECH
(UROP Course: UROP1100, Fall 2012)

In this project, we explored certain background information about liquid-state supercapacitors and compared them with conventional capacitors. We also found the characterization methods for capacitors and used a convection capacitor to become familiar with the application of the source meter used in the characterization. To characterize supercapacitors, we used both industrial and I-V curve methods, comparing them in terms of convenience and accuracy. Knowing that solid-state supercapacitors do have a higher potential benefit, considering working temperature, capacitance and even working voltage relative to the liquid-state supercapacitor, we aim to design and fabricate a solid-state supercapacitor and characterize it using the aformentioned characterization method.

Advisor: *HUANG Baoling / MAE*
Student: *LYE Wilson Wei King / MECH*
(UROP Course: UROP1200, Spring 2013)

As a continuation of a previous project that focused on understanding the behavior of supercapacitors and applying conventional categorization methods to normal capacitors, this project exlores the newest supercapacitor method (I-V curve), material selection and literature on the fabrication method. The material we selected is Polyethylene Oxide/$LiClO_4$. Due to problems constructing the labview program and the delay in material arrival, the electrolyte material experiments have not been conducted. Rather, we tested supercapacitors using different frequency sweep functions.

Graphene/polymer Composites

Advisor: *KIM Jang Kyo / MAE*
Co-advisor: *YOUSEFI Nairman / MAE*
Student: *FARERA Reynaldo / MECH*
(UROP Course: UROP1100, Spring 2013)

Crumpled graphene sheets are prepared using a hydrothermal method. Nanocomposites are prepared using the crumpled graphene sheets. Unlike normal graphene sheets, no alignment is seen in the crumpled sheet nano-composites due to their geometry and low aspect ratio. The bonding between crumpled sheets and epoxy, however, was poor.

Highly Conductive, Transparent Graphene Thin Film

Advisor: *KIM Jang Kyo / MAE*
Co-advisor: *JIA Karen / MAE*
Student: *ASIF Ali Ahmer / MECH*
(UROP Course: UROP1100, Spring 2013)
DANISH Mohammed / MECH
(UROP Course: UROP1100, Spring 2013)

The purpose of this project was to increase the conductivity of thin graphene films, which were developed by depositing four layers of ultra-large graphene solution on a PET substrate. To improve the conductivity of the films, they were reduced using HI acid and then doped by nitrogen.

Advisor: *KIM Jang Kyo / MAE*
Co-advisor: *JIA Karen / MAE*
Student: *PAINTAL Angadvir Singh / MECH*
(UROP Course: UROP1100, Fall 2012)

Graphene and graphene-based polymer nano-composites have gained much attention in the past few years. The important point in obtaining nano-composites with good mechanical properties is the interfacial bonding between graphene sheets and the polymer. Graphene sheets with many wrinkles can be used as a method for increasing the interfacial area and mechanical interlocking between the nano-filler and the polymer. Highly wrinkled graphene sheets were prepared using a simple hydrothermal method. The hydrogels prepared using this method were infused with acetone, which was quickly evaporated at high temperature, resulting in powder-form graphene with a highly wrinkled structure.

Development of Endoluminal Devices

Advisor: *LAM David C C / MAE*
Student: *LI Jiayue / MECH*
(UROP Course: UROP1100, Spring 2013)

The objective of this project was to develop methods for measuring the shear strength of clots – an important step in testing the feasibility of the new thrombectomy method. Suitable experimental set ups were fabricated to create samples. A 6.67%-weight jelly powder was dissolved in a 45˚C water bath, and then cooled for 20 minutes at 18˚C. The jelly was then fixed on the universal testing machine and the strain stress curve was obtained. The shear strength of each sample jelly was determined and the feasibility and reproducibility of the methods were evaluated. Finally, the proposed methods were tested on real blood clots. After testing the samples of jelly with similar properties, the following useful data were obtained: 3.177, 2.675, 2.948, 3.217, 2.974, 3.168 and 3.158 (newtons). The average shear strength was 3.057 (newtons) and the standard deviation was 0.2099 (newton). The success rate was 50%. The method was found suitable for real testing in terms of its feasibility and operability, as the shear fracture process is quite clear and visible, but it still needs modification regarding its reproducibility, as the success rate is only 50%.

Keywords – Clot, jelly, shear stress, strength

Advisor: *LAM David C C / MAE*
Student: *LU Shuhao / MECH*
(UROP Course: UROP1100, Spring 2013)

Cardiovascular diseases such as stroke have become the second leading cause of death in the world. In this project, we explored the development of endoluminal devices for the diagnosis and treatment of cardiovascular diseases. Currently, several endoluminal devices with different technologies are commonly used in clinical operations. To improve their efficiency and safety, we designed a new endoluminal device that uses innovative methods and is divided into various sub-systems – one that detects the target thrombus in the blood vessel dynamically. We designed equipment capable of capturing electrical signals with different strengths and patterns and visually transmitting the location information to an operator. The prototype has been built, but adjustments must be made to realize all of its functions and commercialize the tool.

Design and Fabrication of a Microfluidic CTC Chip for Cancer Diagnostics

Advisor: *LEE Yi-Kuen / MAE*
Co-advisor: *MA Wei Vivian / MAE*
Student: *MA Shuo / MECH*
(UROP Course: UROP1000, Summer 2013)

The design and fabrication of circulating tumor cell (CTC) chips are developing at an amazing speed. There are several approaches to their design. For our project, the method for capturing the CTCs is purely mechanical and based on the size difference between the tumor cells and normal blood cells. We are currently focused on stimulating the flow in the CTC chip using CFDRC software, including CFD-GEOM, CFD-ACE and CFD-VIEW, which can help to determine the dimension and shape of the CTC chip while controlling its flow rate and sample characteristics to avoid low cell viability and capture efficiency.

Biomimetic Design of Flexible Flapping Wings for Micro Air Vehicles

Advisor: *QIU Huihe / MAE*
Student: *KONG Xiangzhou / MECH*
(UROP Course: UROP1100, Spring 2013)

The development of flapping wings for use in micro air vehicles (MAVs) has been widely researched for its promising applications. The key element in such a system is the wing and its design and the pattern of the motion generated will define the characteristics of a flapping wing MAV. This project presents a simple prototype of a controlling system for such a wing and the integration process that would allow it to work with an experimental system involving calibration, monitoring and particle image velocimetry (PIV) while collecting data. This work supports the further study of flapping wing MAVs in the laboratory.

Advisor: *QIU Huihe / MAE*
Student: *XI Siyuan / MECH*
(UROP Course: UROP1000, Summer 2013)

Silk is a magnet material with a number of good chemical and biological properties. We abstract fibroin from silk to make the flapping wing of a flapping micro-air vehicle (FMAV) and explore other uses. We also add another agent to produce a composite, hoping to improve the properties of the material.

Advisor: *QIU Huihe / MAE*
Student: *ZHANG Lun / ELEC-HR*
(UROP Course: UROP1000, Summer 2013)

A flapping-wing micro air vehicle (MAV) has a pair (or two pairs) of insect-like flapping wings that offer abilities such as sustained hovering and agile maneuvering in confined spaces. This project focuses on the flow visualization of water with different kinds of wing flapping motions to find the optimal flapping motions. Particle image velocimetry (PIV) is an entrant to the field of fluid flow measurement and provides instantaneous velocity fields over global domains. A literature review will be conducted to obtain the necessary knowledge to assist the supervisors with the PIV experiment.

Advisor: *QIU Huihe / MAE*
Student: *ZHU Yuanhang / MECH*
(UROP Course: UROP1100, Spring 2013)

Humans have always dreamed of flying. In nature, birds and insects are born aviators that fly by flapping their wings. Inspired by birds and insects, the ancient Greek legend of Daedalus and Icarus and the Chinese Book of Han both describe the use of feathers to make wings for a person to fly. Thanks to aeronautical engineering, people are able to fly from one place to another freely. However, due to the difficulties in fluid dynamics and the mechanical complexity, no manned aircraft has been designed using a pair of flapping wings. Recent research on the application of flapping wings in micro air vehicles (MAVs) has proven popular at numerous universities and institutes. People believe that once the principle of flapping wings is discovered, there will be huge developments in such air vehicles.

Robotic Earthworm

Advisor: *TANG Kai / MAE*
Student: *LUI Hoi Lun / ELEC*
(UROP Course: UROP1000, Summer 2013)

The objective of this project is to discover the capabilities, potential applications and developmental potential of soft, robotic actuators such as McKibben Muscles and their pros and cons over rigid mechanical actuators. The project required that all involved familiarize themselves with the theories, designs, fabrications and tests of the soft robotic earthworm and gripper.

The soft actuators have shown outstanding flexibility and resistance to wear and impact. In numerous tests passed by the soft actuators, conventional rigid mechanical actuators required overly complicated designs and still barely passed the tests, if they did not fail outright. Yet, the fundamental flaws of the soft actuators cannot be ignored, especially the low speed, restrained movement and demand for a high-pressure air supply.

Soft robotics might open a new area of robotic actuators where the strengths and qualities of soft and rigid mechanical parts are combined.

Keywords – Soft robotics, Soft actuators, Pneumatic artificial muscles, Elastomers, Locomotion, Peristalsis, Robotic earthworm, Robotic arm, Robotic gripper

Measurement of Liquid-liquid Interfacial Tension in a Microfluidic Device

Advisor: *YAO Shuhuai / MAE*
Student: *YAO Yuan / MECH*
(UROP Course: UROP1000, Summer 2013)

In this project, we compare the measurement methods of interfacial tension between oil and water to check whether the new micro fluidic device is valid when the vertical pressure difference is neglected. Upon comparing the value of oil-water interfacial tension both in the traditional method (by using a droplet machine or goniometer) and in the microchip channel, the outcomes are not quite comparable. Thus, we check several kinds of oils such as mineral oil, vegetable oil, n-Alkane oil, etc. The results provide strong evidence that bipolarized components, such as palmitate content, dominate the interfacial tension value. Thus, we conversely make use of these accurate values and find the inaccuracy of the micro device. By changing the measurement principle, we offset the vertical direction and finally verify this new micro fluidic device.

Keywords – interfacial tension; micro fluidic device; pendant drop method; polarized component.

Study of Dropwise Condesation on Nanoengineered Surfaces for Enhanced Thermal and Water Harvesting

Advisor: *YAO Shuhuai / MAE*
Student: *HAN Zhuofei / MECH*
(UROP Course: UROP1100, Spring 2013)

When condensed droplets coalesce on a super-hydrophobic nano-structured surface, the resulting droplet can jump from the surface due to the release of excess surface energy. If designed properly, these super-hydrophobic nano-structured surfaces can not only allow for easy droplet removal at micrometric length scales during condensation, but may even enhance heat transfer performance. However, preliminary research indicates a counterintuitive decrease in condensation heat transfer on nano-structured surfaces in vapor chamber condensation experiments. Because the film-wise condensation forms on the nano-structured surface in a high heat flux and saturation pressure environment, the surface energy released from coalescence condensate droplets cannot overcome the energy barrier for the Wenzel to Cassie transition, due to the strong pining of the file-wise condensate. Nevertheless, the nano-structured super-hydrophobic surface shows a significant condensation heat transfer enhancement at a low saturation pressure environment, which provides an approach to increasing the efficiency of applications such as atmospheric water harvesting and dehumidification. This project aims to create an experimental setup to evaluate the thermal characteristics of nano-engineered surfaces at a low saturation pressure.

Design and Evaluation of RFID Systems

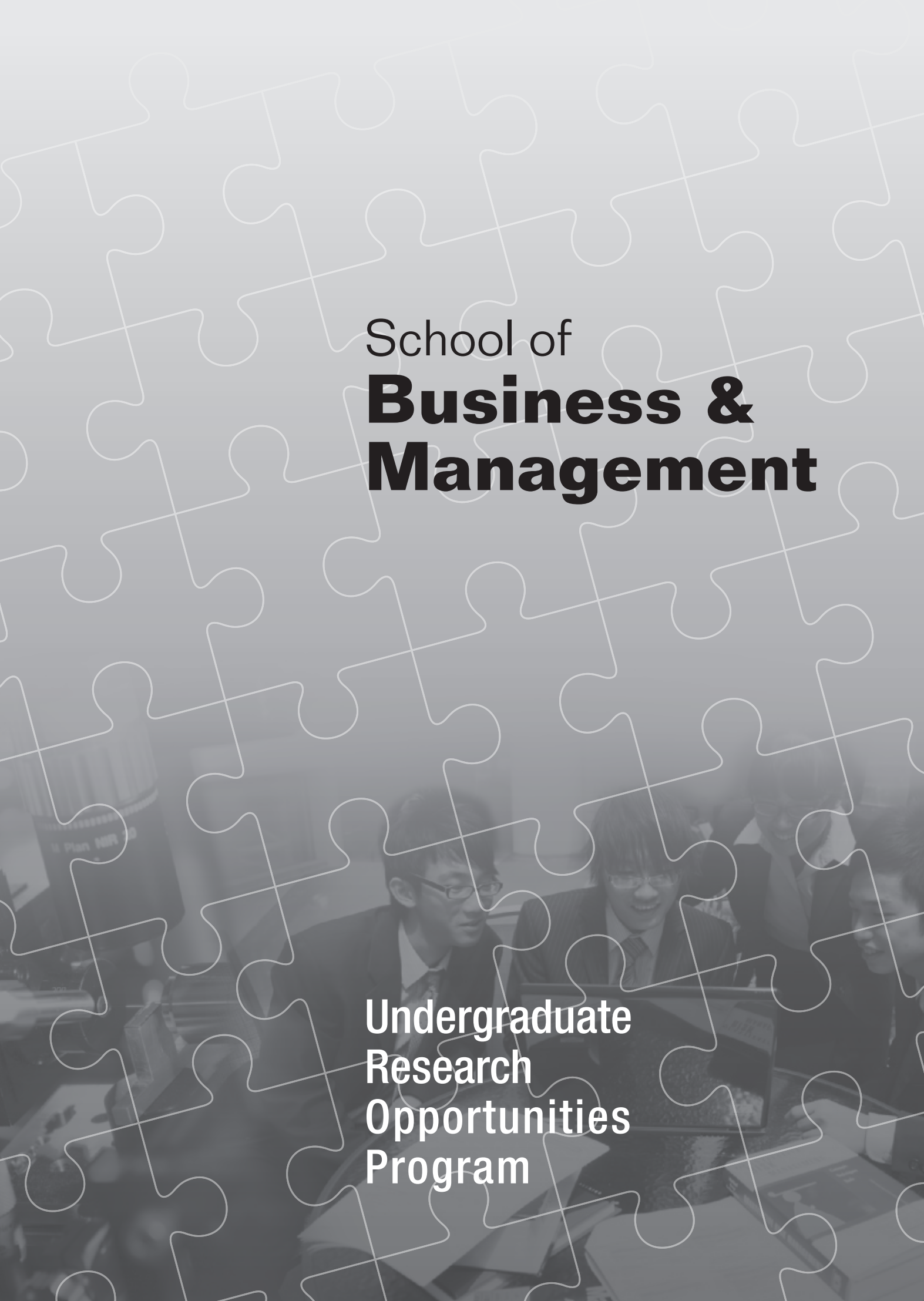
Advisor: *YUEN Matthew M F / MAE*
Student: *CHAN Kwan Yin / MECH*
(UROP Courses: UROP1100, Fall 2012;
UROP1200, Spring 2013)

Radio-frequency identification (RFID) tags are widely used in many applications. However, the design of antenna is limited by low antenna gain. Thus, electromagnetic bandgap (EBG) is used as the substrate of the RFID tag to work on metal surfaces. This project examines the design of an EBG substrate RFID tag. The EBG substrate is simulated by finite element method (EFM) stimulation software and an Ansoft high frequency structure simulator. The results of antenna gain are seen in the antenna radiation pattern.

Advisor: *YUEN Matthew M F / MAE*
Student: *LALITNANTAWAT Anon / MECH*
(UROP Course: UROP1100, Fall 2012)

Radio-frequency identification (RFID) technology is interactive identification systems with higher efficiency than other identification system because the identification data can be easily checked, tracked and edited through computers or other mobile devices. RFID is a promising technology for many industries (retail, logistics, manufacturing, etc.), but improvements are needed to fully integrate RFID into a real-world setting. The first part of this project focuses on RFID tag technology while the second part examines RFID tag readers.

School of
Business & Management



Undergraduate Research Opportunities Program

Department of Accounting

Financial Analysts' Role in Post-Earnings Announcement Drift

Advisor: *HUANG Allen H / ACCT*
Student: *CHU Tai Hang / ECOF*
(UROP Course: UROP1000, Summer 2013)

This project examines the feasibility of an easily implemented trading strategy for capturing the abnormal returns from post-earnings-announcement drift (PEAD) and its related phenomenon, from a transaction cost perspective. Following previous research, share price, dollar trading volume and the proportional bid-ask spreads are chosen to proxy for the inverse of the direct and indirect costs of trading. The evidence from this project suggests that transaction costs and risk compensation may be the major reasons why PEAD exists in this simple trading strategy, which can be used by ordinary investors.

Advisor: *HUANG Allen H / ACCT*
Student: *WOON Xin Yi / ACCT*
(UROP Course: UROP1000, Summer 2013)

This study presents evidence that consumer confidence level responds to the current earnings announcements, causing significant variations in post-earnings announcement drift (PEAD). I suggest that these variations are caused by changes in individual shareholders' perceptions of the economy's performance, such that the correlation between PEAD and consumer confidence can be either positive or negative according to the synchronism of consumer confidence. More importantly, the magnitude of the drift is narrowing with the time axis, implying a more efficient market in which financial analysts and stakeholders are more responsive to market events.

Advisor: *HUANG Allen H / ACCT*
Student: *YE Yuqian / ACCT*
(UROP Course: UROP1000, Summer 2013)

This study examines whether post-earnings announcement drift (PEAD) has persisted since its initial discovery in the 1960s, and whether the transaction cost and market value of firms influence it. Statistics are tested using a hedge portfolio return strategy that longs the stocks with the highest earning surprise and shorts those with the lowest. The results show significant PEAD persistence, prompting a hypothesis that some of the trading barriers in inefficient markets have prevented the elimination of PEAD. Under assumption and manipulation, the results show that transaction costs negatively influence PEAD, whereas market value exhibits a positive influence, with both contributing to its cause.

Keywords: PEAD, transaction cost, market value, hedge portfolio return

Advisor: *HUANG Allen H / ACCT*
Student: *ZHANG Yiming / ACCT*
(UROP Course: UROP1000, Summer 2013)

This study first examines the existence of post-earnings announcement drift (PEAD) from 2002 to 2008 as an extension of the literature while exploring the potential effects of analyst quantity following the companies to the PEAD. The results show that PEAD still exists and that a greater quantity of analysts following the companies mitigates the magnitude of PEAD. This project contributes to the literature on discovering factors that lead to PEAD. One implication for companies is that hiring more analysts to follow may increase the accuracy of return forecasts.

Portfolio Management and Research Operation Tools

Advisor: *LI Xi / ACCT*
Student: *JIANG Mengfei / QFIN*
(UROP Course: UROP1100, Summer 2013)

This project describes the data collection and verification processes when studying the relationship between a billionaire's wealth level and his/her controlled quoted company's performance.

Advisor: *LI Xi / ACCT*
Student: *LI Wanqi / SBM*
(UROP Course: UROP1100, Summer 2013)
XIAO Chenhao / ECOF
(UROP Course: UROP1100, Summer 2013)

This project focuses on using software (such as SQL, Perl, Python, MATLAB or SAS) and web-building tools to maintain security and build analytic and portfolio management tools and wrappers that link with and automatically update databases, in addition to other ad hoc programming and database tasks. Prior experience with some of the abovementioned software is not required. Those with programming experience will learn new software quickly.

Conference Calls and Information Discovery

Advisor: *NOVOSELOV Kirill / ACCT*
Co-advisor: *HSIEH Chia-Chun / ACCT*
Student: *CECUTTI Lorenzo / BUS*
(UROP Course: UROP1100, Spring 2013)

In this project, I conduct a review of the conference calls/information discovery literature to jump start my decision theory research. I describe the software work that has been done to help with data analysis, and although it was not initially a major component of this research project, it has proven to be of substantial interest due to the problems encountered and has shed new light on the work of researchers.

Department of Economics

Firms in Globalization: Evidence from China

Advisor: *LI Yao / ECON*
Student: *CUI Yiye / MAEC*
(UROP Course: UROP1100, Spring 2013)
HE Yi / FINA
(UROP Course: UROP1100, Spring 2013)

This project explores the economic behavior of different types of firms in China, including indigenous firms and foreign invested enterprises (FIEs). The agglomeration of each industry is examined through data collected from both local and foreign firms located in China and the process description, methodology and learning experience are described.

Advisor: *LI Yao / ECON*
Student: *CUI Yiye / MAEC*
(UROP Course: UROP1200, Summer 2013)

This project explores the economic behavior of different types of firms in China, including indigenous firms and foreign invested enterprises (FIEs). Data are collected on the total employment of provinces and cities in 2009, and population and employment of all provinces and industries from 1998 to 2009, respectively. The agglomeration of each industry is examined through data collected from both local and foreign firms located in China and the process description, methodology and learning experience are described.

Advisor: *LI Yao / ECON*
Student: *KAN Chen / SBM*
(UROP Course: UROP1000, Summer 2013)

Taiwanese investments have played an increasingly important role in mainland China, especially in the electronics industry. This project analyzes Taiwanese investments in the electronics field. The main task is divided into two parts. First, China's enterprise (CIE) and the Taiwan invested firm (TIF) databases are updated. Second, firms that invest in Taiwan through CIEs by merging are chosen and their trade type and value analyzed using China's custom data. All of this work is conducted through the software Stata. This project reports the process and result of the analysis while noting the problems encountered at every step.

Advisor: *LI Yao / ECON*
Student: *LAO Jeffrey / SBM*
(UROP Course: UROP1000, Summer 2013)

This project explores the economic behavior of different types of firms in China, including an analysis of firms' economic decisions to export or import. Previous UROP students compiled a CIE database containing all of mainland China's firms during the 2000-2007 period. Given the existence of the 2008 data, this file is updated to "no duplicate (2000-2008)" and then the matched Taiwanese invested firms in CIE are paired with the China Customs import-export data. This enables the study of the trade composition of Taiwanese invested electronics firms in mainland China. During this project, the process of matching Taiwan invested firms' and custom data is completed, as is the analysis of Taiwanese invested electronics firms' trade patterns. Hence, this progress report mainly presents how the matching process and data analysis were accomplished with the Stata software.

Advisor: *LI Yao / ECON*
Student: *LIANG Yuanning / ECOF*
(UROP Course: UROP1200, Fall 2012)

This project explores the economic behavior of different types of firms in China, analyzing their decisions to export or import and how those decisions interact with other firm characteristics. Specifically, the importing and exporting behavior of Taiwanese invested firms in mainland China are examined by comparing the data collected from Chinese Customs with those collected from Taiwanese parent firms' records. These firms' trading types reveal details about their main businesses and the process description, methodology and learning experiences are described.

Advisor: *LI Yao / ECON*
Student: *MARK Wai Sun Joe / ECON*
(UROP Course: UROP1000, Summer 2013)

This project examines the economic behavior of different types of firms (indigenous and foreign invested enterprises) in China by analyzing a representative firm's economic decision to export or import, and its interaction with the firm's other characteristics such as productivity, innovation and locational choice. This report focuses on exploring the agglomeration index of each industry in China to determine the correlations between the city and province levels. This report describes my related work experience and learning process.

Advisor: *LI Yao / ECON*
Student: *TSOI Ho Yin / ECOF*
(UROP Course: UROP1200, Fall 2012)

In this age of globalization, many large companies set up subsidiaries in different countries to save costs. China, as the target of many multinational corporations, has experienced a significant increase in the number of affiliates established there since the Reform and Opening in the late 1970s. Does the economic behavior of the subsidiaries differ from that of the local firms in China? More specifically, is the relocation rate different for different types of firms according to their capital structure? This report compares the changes in the geographical locations of domestic firms, Taiwanese-invested firms (TIFs) and other foreign-invested firms (FIFs). Before an analysis can be conducted, some data-processing work must be done to construct samples. Based on our findings, we discover that on the whole, firms in China tend to stay at their initial location. We also note that the relocation rate of TIFs and FIFs is higher than that for domestic firms, and explanations are provided.

Advisor: *LI Yao / ECON*
Student: *WANG Shiqi / ECOF*
(UROP Course: UROP1200, Fall 2012)

Recent years have seen a rise in the imports and exports of Taiwanese invested firms in mainland China. To analyze the trade types of these firms, some data processing work was carried out. First, the import and export transactions were separated from the entire list of Taiwanese invested firms by matching China's simplified customs records. Second, the matched enterprises were linked to those in the full version of the customs record, and detailed information about specific trade types was obtained. A simple statistical analysis of the trade types was accomplished based on the previous empirical investigation, which shows rather different trading patterns between firms doing export and import business and between Taiwanese invested firms and all of the firms in customs, recorded as a whole.

Advisor: *LI Yao / ECON*
Student: *XIA Yicong / ECOF*
(UROP Course: UROP1100, Summer 2013)

This project investigates the degree of agglomeration of local and foreign firms (both in China) using an EG index of agglomeration. The data collected are from 2001 to 2007. The results of the agglomeration patterns within different types of firms in China provide insights into economic behavior.

Advisor: *LI Yao / ECON*
Student: *ZHANG Bingjun / MAEC*
(UROP Courses: UROP1100, Fall 2012;
UROP1200, Spring 2013;
UROP1300, Summer 2013)

The key to studying the import and export trading patterns and constituents of Chinese firms using customs data is to match the customs HS codes with the product codes from the National Bureau of Statistics of China. In this continuing project, several methods have been tested to determine the best way to achieve such matching and obtain a well-refined concordance between the HS and product codes. No large-scale, systematic analysis has been conducted thus far, so this report will mainly present ways of getting and refining the matching concordance, and descriptions of the other simple analyses performed. Stata statistics software is used throughout the project to facilitate data processing and analysis.

Understanding the Savings Constraints of Migrant Domestic Workers

Advisor: *VISARIA Sujata / ECON*
Co-advisor: *LEE Clarence M F / ECON*
Student: *NAN Shengyue / ECON*
(UROP Course: UROP1100, Spring 2013)
ZHANG Xialing / ECON
(UROP Course: UROP1100, Spring 2013)

This project examines the savings behavior of migrant domestic workers (MDWs) in Hong Kong to develop an understanding of why they make bad financial decisions, prefer to borrow at higher interest rates and typically do not manage to save enough of their income. A controlled experiment introducing savings boxes to MDWs reveals whether such a product can help MDWs build better saving habits and improve their financial situation. This progress report describes the learning process and work achieved throughout this semester.

Advisor: *VISARIA Sujata / ECON*
Co-advisor: *LEE Clarence M F / ECON*
Student: *NAN Shengyue / ECON*
(UROP Course: UROP1200, Summer 2013)

This project considers the progress of the 'Understanding the Savings Constraints of Migrant Domestic Workers' project and reviews the research discussed throughout the summer semester. Our working method became more systematic entering the collection stage as we and the migrant domestic workers (MDWs) grew more familiar with the routine. The reading we have done has provided a general picture of the financial situation of the world's poor and the theoretical framework for microcredit and microfinance, with insights provided by experiments conducted in different social settings. All of it has proven vital knowledge for developing a better understanding of the experiments we are currently running.

Advisor: *VISARIA Sujata / ECON*
Co-advisor: *LEE Clarence M F / ECON*
Student: *TAN Leafynn / MAEC*
(UROP Course: UROP1100, Summer 2013)

This project examines the savings behavior of migrant domestic workers (MDWs) in Hong Kong to better understand why they make suboptimal financial decisions, often preferring to borrow at higher interest rates or save insufficiently. In a controlled field experiment, savings boxes are introduced to MDWs with the belief that they will help build better saving habits among and improve the financial situations of MDWs. In addition to the Advisor and Co-advisor, I have worked with the co-supervisor, Song Chenlu, Nan Shengyue, Zhang Xialing and Zhou Feng on this project. This progress report describes my work and learning process throughout the term.

Advisor: *VISARIA Sujata / ECON*
Co-advisor: *LEE Clarence M F / ECON*
Student: *ZHANG Xialing / ECON*
(UROP Course: UROP1200, Summer 2013)

This project examines the Asian Migrant Credit Union's (AMCU's) rough treatment of migrant domestic workers (MDWs) in Hong Kong to determine why the latter do not save much and prefer to take loans with higher interest rates with the goal of finding a way to help them accumulate financial savings.

Advisor: *VISARIA Sujata / ECON*
Co-advisor: *LEE Clarence M F / ECON*
Student: *ZHOU Feng / FINA*
(UROP Course: UROP1100, Summer 2013)

This project studies the saving and consumption behavior of migrant domestic workers (MDWs) in Hong Kong through both theoretical analysis and practical investigation. We begin by interviewing MDWs and acknowledging their financial savings, withdrawals, payments and transfers (both in and out). We use pre-designed charts and saving boxes to record the data. Then, we review the literature on related topics such as microfinance, rural credit cooperatives and motivation of joint-liability, which allows us to dig deeper into the essence of the problematic behavior. The project produces advanced economic models, important research methods and analytical skills.

Mid-Income Trap, International Trade and Economic Growth

Advisor: *WANG Yong / ECON*
Student: *LI Jin / MAEC*
(UROP Course: UROP1100, Summer 2013)

This project analyzes data from different sources using various measures to examine the relationships between GDP per capita (PPP), GDP growth rate and production service, consumption service, manufacturing industry, entry barrier and labor force scale. Empirically, a large demand for the expansion of consumption service boosts the development of production service, but the industry is not efficient enough to compensate for the increasing cost of labor, which might be one of the dynamics that creates a middle-income trap situation.

Keywords – vertical structure, GDP per capita, GDP growth rate, production service, consumption service, manufacturing industry, entry barrier, labor force scale, efficiency, middle-income trap

Advisor: *WANG Yong / ECON*
Student: *LIANG Yuanning / ECOF*
(UROP Course: UROP1100, Summer 2013)
SHU Shi Yuen / MAEC
(UROP Course: UROP1100, Summer 2013)

We use various methods to test how high income countries' innovation, lower-income countries' imitation and international competition affect the convergence of middle income countries' per capita income toward high income status, as described in a three-country model extended from Krugman (1979). When using patent activities to approximate innovation and imitation, the former's effect on income convergence is insignificant and inconsistent. Export values and varieties are also of insignificant importance. However, trade data reveal that the convergence of an income gap is positively related to the number of export varieties that a country enjoys – exclusive to a comparative advantage over its immediate chasers in terms of per capita income.

Advisor: *WANG Yong / ECON*
Student: *XU Minjie / MAEC*
(UROP Course: UROP1100, Summer 2013)

This project examines the differences in social-economic indicators between economies that have escaped the so-called middle-income trap, and those that have been trapped for decades. I explore the mechanisms behind the correlation between income inequality and economic growth. Empirical evidence suggests that an economy is more likely to escape from the trap when there are low levels of income inequality, a low poverty ratio and higher service sector shares within emerging markets. In particular, my analysis of a closed economy model with a monopoly on the service sector shows that the Gini index, an indicator highly associated with income inequality, decreases as an economy grows under certain conditions on its income distribution.

Regional Inequality and Economic Growth: An Open Economy Perspective

Advisor: *WANG Yong / ECON*
Student: *XU Xiuqi / EEGBM*
(UROP Course: UROP1100, Summer 2013)

This project explores regional inequality and structural change in mainland China over the past 30 years. China's structural change process differs from that of the U.S. in various ways that require further investigation into the mechanism behind regional inequality. More GDP has been contributed by secondary and tertiary industries, with more people moving from the primary to the secondary and tertiary industries. Meanwhile, regional inequality experienced a divergence, and has now been converging for years. The current situation could be due to the high labor mobility in China, the lower demand for primary industry products or the faster productivity growth in secondary and tertiary industries.

Structural Change, Real Exchange Rate and Growth

Advisor: *WANG Yong / ECON*
Student: *CHEUNG Ying Lun / QFIN*
(UROP Course: UROP1100, Spring 2013)

The aim of this project was to study how the dynamics of the real exchange rate between large developing and developed countries is affected by the structural changes of the respective countries. Two fundamental issues are the definition and calculation of the real exchange rate, and the data sources. The calculation of the real exchange rate is discussed based on the literature, while a brief description is given of the exchange rate data available from public sources.

Advisor: *WANG Yong / ECON*
Student: *TSUI Ho Yan Michelle / ECON*
(UROP Course: UROP1100, Spring 2013)

This project explores fluctuations in the real exchange rates of the U.S. and China by observing fluctuations in the relative prices of tradable and non-tradable goods. The bilateral exchange rate between the U.S. and China is computed following two methods used in Charles Engel's "Accounting for U.S. Real Exchange Rate Changes" (1991). The primary results suggest that movements in the prices of non-tradable goods accounts may reflect a significant portion of bilateral exchange rate movement. Subsequently, the project's computation and research limitations are noted and the data source is briefly introduced.

Department of Finance

Student-Managed Investment Fund

Advisor: *CHAN Ka Lok / FINA*
Co-advisor: *LIANG Samuel X / FINA*
Student: *FAN Zhenchuan / ECOF*
(UROP Course: UROP1000, Summer 2013)

In this project, three student-managed investment funds (SMIFs) currently holding stocks (June and July) – 0020.HK, 0801.HK and 0830.HK – are reported. In addition to the funds' news, basic company research reports are provided for the three SMIFs. The stock prices' 2-month performance, basic company information and investment arguments are summarized and analyzed. It has been recommended that stocks 0020.HK and 0801.HK be held. The three stock reports are mostly based on their past performance and annual reports. However, as these three companies are going to release their semiannual reports in mid-August, it is recommended that a SMIF should revalue these stocks in early September.

Advisor: *CHAN Ka Lok / FINA*
Co-advisor: *LIANG Samuel X / FINA*
Student: *LAU Yiu Shing / QFIN*
(UROP Course: UROP1000, Summer 2013)

This project comprised two parts. The first covers market news updates and the fundamental analysis of stocks while the second examines the effects of different cut-loss strategies on potential student-managed investment fund (SMIF) portfolio holdings.

News updates can be further divided into macro environments and company-specific variables to evaluate the changing dynamic of China's credit crunch, the potential crisis in the Euro-area and the United States' recovery. With regard to companies, the respective industry and company details are summarized and analyzed regarding their effects on the companies' valuations.

For the cut-loss strategies analysis, the returns and variations on a 10-year horizon are studied with respect to four different cut-loss methods.

Advisor: *CHAN Ka Lok / FINA*
Co-advisor: *LIANG Samuel X / FINA*
Student: *SO Wai Chung / RMBI*
(UROP Course: UROP1000, Summer 2013)

In this project, we analyze the performance of cut-loss strategies in the Hong Kong stock market because it is the only market in which our fund invests. Portfolios consisting of more than 400 equally-weighted stocks in Hong Kong are examined and we find that the strategies' performance depends on market conditions. Generally, the strategies underperform in our examination period (2003-2012).

Subsequently, we update our research reports on current investments. Three utilities stocks are updated: Beijing Enterprises Water Group (371.HK), China Longyuan Power Group (916.HK) and China Power International Group (2380.HK). We recommend holding the stocks and revise their target prices at the end of 2013.

Index Terms – Backtesting,Cut-Loss Strategies, Investment Review, Equity Research

Advisor: *CHAN Ka Lok / FINA*
Co-advisor: *LIANG Samuel X / FINA*
Student: *WONG Chun / ACCT*
(UROP Course: UROP1000, Summer 2013)

China Mobile and China Comservice are working on their 4G networks as expected. The estimated earnings per share (EPS) and stock price of China Mobile and China Comservice (in 12 months) will be HKD8.16 and HKD85.05, and HKD0.51 and HKD5.80, respectively.

TravelSky Tech has been proactively diversifying its businesses by engaging in other IT-related sectors. Its estimated EPS in 2013 and the target price in 12 months will be 0.537 HKD and 6.92 HKD, respectively.

Stop loss strategies can reduce the systematic risks of a portfolio investment. The effects of stop loss strategies on a portfolio's return depend on the market performance.

Rights Issues around the World

Advisor: *LIANG Samuel X / FINA*
Co-advisor: *DASGUPTA Sudipto / FINA*
Student: *FONG Kai Yan / ACCT*
(UROP Course: UROP1000, Summer 2013)

The aim of this project is to look for insights into the relationships between the popularity of rights issues, bonds and seasoned equity offerings (SEOs) and the profit maximization of companies and investors in the market worldwide. Our research covers countries in different regions, of various economic sizes and levels of development, with diverse economic growth dynamics, through the characteristics that reflect the relationships most clearly.

Advisor: *LIANG Samuel X / FINA*
Co-advisor: *DASGUPTA Sudipto / FINA*
Student: *GUAN Guhan / MAEC*
(UROP Course: UROP1000, Summer 2013)

Rights issues are a major source of raising external capital in many places, including the U.K., Hong Kong and China. In a rights offering, issuers give existing shareholders the right to buy new shares at a specified price. Because they allow existing shareholders to avoid dilution, rights offerings are favorably regarded by regulators outside the U.S. and mandatory in many European and Latin American countries. Given that this project is in a start-up period, we collect the historical record first, and then use the information to analyze the stock performance of rights issuance.

Advisor: *LIANG Samuel X / FINA*
Co-advisor: *DASGUPTA Sudipto / FINA*
Student: *HO Kin Nock / ACCT*
(UROP Course: UROP1000, Summer 2013)

We collected data on rights issues, seasoned equity offerings (SEOs) and debt issuance. Using the Bloomberg Terminals towe accessed and analyze the 20-year data for Canada, Argentina, Kuwait, Thailand, Denmark, South Africa and South Korea. We found that different countries had different preferences regarding external financing methods. In Canada, there was 5.6 times more debt issuances than rights offerings and the majority of bonds were zero-coupon bonds. In Argentina, there was no SEO during the past two decades. In Kuwait and Thailand, the number of rights offerings outweighed the number of debt issuances. This project supported the existence of the so-called ‘rights issue puzzle’.

Advisor: *LIANG Samuel X / FINA*
Co-advisor: *DASGUPTA Sudipto / FINA*
Student: *WAI Hogan Kok-fung / GBUS*
(UROP Course: UROP1000, Summer 2013)

Rights offerings are one of the methods a firm can use when attempting to raise capital. Other methods include seasoned equity offerings (SEOs) and debt. We are particularly interested in whether firms prefer to use right issues and how this preference varies across different countries. As this is the first stage of data collection and analysis, this report is descriptive in nature.

Keywords – rights issues, shareholders, tradable rights, total events

Advisor: *LIANG Samuel X / FINA*
Co-advisor: *DASGUPTA Sudipto / FINA*
Student: *YUAN Xinchen / SBM*
(UROP Course: UROP1000, Summer 2013)

Rights issues are a major source of raising external capital in many countries that are theoretically well-designed and have very few disadvantages. We collect data from 8 countries for 22 years to see how rights issues operate in different countries and determine what makes them so popular. For the sake of comparison, data is also collected on debt issuance and seasoned equity offerings (SEOs). We then describe the data, indicate interesting and unique phenomena in each of the countries studied and make suggestions for further research.

Keywords — Rights Issues, Warrant, Entitlement, Open offer, Debt, SEO, Japan, Taiwan, Turkey, Austria, Russia, Portugal, Indonesia, Peru, Bloomberg terminal, 22 years (1990-2013)

Political Connection, Political Uncertainty and Asset Pricing

Advisor: *LIU Xiaolei / FINA*
Student: *GE Jingyi / SBM*
(UROP Course: UROP1000, Summer 2013)
YE Yiqi / GBUS
(UROP Course: UROP1000, Summer 2013)
WANG Tianyu / FINA
(UROP Course: UROP1100, Summer 2013)

This report presents the data collection, data processing and information extraction process for the research project 'Political connection, political uncertainty and asset pricing'. The processing mechanism is a combination of manual work and VBA programming. We present the logic behind the VBA programs developed and the improvements that were adopted over time to facilitate data processing. Because the project is still in progress, data analysis and results derivation have not been completed and thus are not discussed in this report.

Advisor: *LIU Xiaolei / FINA*
Student: *TIAN Ou Ya / FINA*
(UROP Course: UROP1100, Summer 2013)

The effects of political connection and uncertainty on asset pricing are gaining increasing attention, especially in relation to countries such as China, because they are poised at the brink of reformation and their political decisions significantly influence every social field. The Bo Xilai scandal that broke in February 2012 was a political tsunami for China, given Bo's huge amount of unexplained assets, deep connection with local firms and close involvement with the Princelings. We assume that his falling out would prompt considerable vibrations in companies' stock performance. To test this hypothesis, we compare the stock volatilities of listed companies defined as being politically associated with Bo against the market average. Such a connection is identified through: 1) firms whose board directors have government working experience, especially in departments that overlapped with or related to Bo's; 2) firms controlled by Bo's family members and close business partners; and 3) firms in cities where the highest governors are considered Princelings or have worked within the Princelings' sphere of influence. We find that the effect in the stock market is sufficiently significant in terms of the proximity of locations or factions.

Advisor: *LIU Xiaolei / FINA*
Student: *ZHANG Zhijun / COMP*
(UROP Course: UROP1100, Summer 2013)

We study the Bo Xilai scandal in 2012 and its influence on various companies listed in the stock exchange. We hope to dig out all of the related asset pricing changes and thoroughly explain them. In addition, we use this specific event as an example to gain a better understanding of the underlying relationship between political events and asset pricing changes.

The Economic Impact of Hong Kong's Investment-Fund Policy

Advisor: *MACKAY Peter Ian / FINA*
Co-advisor: *LAFON-VINAIS Veroniq / FINA*
Student: *CHENG Yan Yu / GBUS*
(UROP Course: UROP1100, Spring 2013)

This country report provides an overview of Luxembourg's role as a global fund management center. Beginning in the 1980s, Luxembourg's financial service sector managed to become an attractive hub for distributing retail funds (Undertakings for Collective Investment in Transferable Securities (UCITS) directives) and the leading cross-border center for fund administration both inside and outside of Europe. In the 2000s, Luxembourg has extended its offerings to serve the growing alternative asset sectors such as real estate, private equity and hedge funds.

Advisor: *MACKAY Peter Ian / FINA*
Co-advisor: *LAFON-VINAIS Veroniq / FINA*
Student: *WANG Yumeng / FINA*
(UROP Course: UROP1100, Spring 2013)

The self-governed overseas territories of the U.K., the Cayman Islands and Bermuda, have successfully established reputations as leading offshore financial centers in the past few decades. The success of the Cayman Islands and Bermuda as offshore financial centers can be attributed to several common factors: well-established infrastructure, political stability, highly regarded legal system, tax free status and availability of professional service providers. However, the divergence in the regulatory adjustments has also led the two countries to different business focuses, with the Cayman Islands reinforcing its position in the investment fund industry and Bermuda developing into a giant in the insurance and reinsurance business. This project examines the changes in financial regulations held by the Cayman Islands and Bermuda to determine which factors contribute to the success of their investment fund industry and explore the causes for the divergence in their business focuses.

Department of Information Systems, Business Statistics and Operations Management

Dynamic Copula Models

Advisor: *SO Mike K P / ISOM*
Student: *FUNG Wai Kit Jacky / RMBI*
(UROP Course: UROP1300, Fall 2012)

We propose a new dynamic copula model to describe the dependence structure between time series variables. Existing dynamic copula models assume a particular parametric form of the copula function. Incorrectly specifying the copula function can lead to unsatisfactory inference or poor prediction. We aim to estimate dynamic copula function nonparametrically via kernel functions. Using a kernel-based approach to estimate time-dependent copula function provides a smooth and continuous copula while allowing dependence measures to evolve over time. We apply the model to multiple financial time series to understand the time series properties of the dependence among financial returns.

Bayesian Analysis of Spatial Extremes

Advisor: *SO Mike K P / ISOM*
Student: *WANG Yixin / MATH-ST*
(UROP Course: UROP1300, Fall 2012)

The Bayesian spatial modeling of extreme values has become increasingly popular for its usefulness in obtaining relevant uncertainty measures of estimates. We propose a Bayesian hierarchical model to describe the dependence of extreme return levels on spatial locations and duration periods. The exceedance over threshold approach is adopted to characterize extreme intensities. We pool the data from all duration periods and incorporate duration periods as one of the covariates characterizing the latent spatial process that drives the behavior of generalized Pareto distribution (GPD) parameters. This potentially avoids possibly nonsensical return-level estimates produced by modeling data from different duration periods separately. The models are fitted using a Markov chain Monte Carlo (MCMC) algorithm to perform a Bayesian hierarchical inference for the model parameters and uncertainty measures. The methodology is applied to the real precipitation data.

Keywords – Bayesian analysis; generalized Pareto distribution; hierarchical model; multiple duration; spatial extreme.

Two-Sided Matching and Sorting

Advisor: *ZHANG Michael X / ISOM*
Student: *CHAN Ming Hong / ECOF*
(UROP Course: UROP1100, Fall 2012)

I explore some of the underlying factors affecting the reply rate. Because there is an enormous amount of data, 10 samples with 100,000 users each (the population of users is about 3.75 million) and 20 samples with 100,000 messages each are extracted randomly to avoid any selection bias.

Advisor: *ZHANG Michael X / ISOM*
Student: *SHI Chenlai / ECOF*
(UROP Course: UROP1100, Fall 2012)

This project reports on the details of my exploration of our data sets under the focus of examining the effects of Hukou and migration on people's decisions. I summarize the data for a better view of the entire database. Based on the literature review and test results, I conclude that the focus could be impractical in testing, at least at its current stage. Thus, I am pursuing other models to further exploit the implications of people's potential ranking or searching behavior.

Department of Management

Multiculturalism, Social Judgments and Decisions

Advisor: *CHAO Melody Man Chi / MGMT*
Student: *LEUNG Wing Hay Eiki / GBUS*
(UROP Courses: UROP1200, Fall 2012;
UROP1300, Spring 2013)

Multiculturalism has long been celebrated as an ideology that may help resolve inter-group conflicts and reduce prejudice. Although an increasing number of people have started to endorse this multicultural ideology, little is known about how the endorsement of multiculturalism influences individuals' attitudes toward social policies that have different distal and proximal implications for the society. This project reveals that the benefits of a multicultural ideology remain at the ideological (distal) level, but do not apply at the practical (proximal) level. Individuals who endorse multiculturalism indicate stronger support for social policies designed to promote fairness and equality at the ideological level; however, they indicate lower support for social policies that actually promote fairness and equality for all in practice. The implications of these ironic effects of multiculturalism are discussed.

Advisor: *CHAO Melody Man Chi / MGMT*
Student: *SHI Ning / GBUS*
(UROP Course: UROP1100, Summer 2013)

The 'rural migrant' is a distinct social category in mainland China's cities. Such migrants encounter unique social psychological challenges in adjusting to city life. Using data from a two-wave time-lagged study that involved 55 rural migrant workers' children in mainland China, this project investigates the adjustment experiences of rural migrants. Specifically, the relationship between essentialist beliefs and rural migrant adjustment in urban cities is studied. Essentialism refers to the belief that each social category (e.g., rural vs. urban residents) possesses immutable attributes that are indicative of members' abilities and traits. The findings from this project show that rural migrants who endorse essentialist beliefs are more likely to experience difficulty in adjusting to an urban cultural environment. The implications for cultural adjustment and social integration are also discussed.

Advisor: *CHAO Melody Man Chi / MGMT*
Student: *XIONG Kangying / ACCT*
(UROP Course: UROP1300, Spring 2013)

Previous research has identified various antecedents to cross-cultural adjustment; however, little is known about the interpersonal and intrapersonal psychological processes underlying adjustment outcomes. This project investigates the psychological processes of adjustment by examining it as an accumulation of intercultural experiences over time. Specifically, I investigate how individuals' beliefs and assumptions about culture color their subjective perceptions and shape their interpersonal dynamics in intercultural contexts.

Negative Ties in the National Basketball Association

Advisor: *CHOI Joon Nak / MGMT*
Student: *ZHAO Tianyu / SBM*
(UROP Course: UROP1000, Summer 2013)

This project explores the basic preparation and research methods for studying social ties between agents and teams in the National Basketball Association (NBA), and their effects on players' salaries. The tasks assigned to the participating student are described along with the procedures used to complete them. The results of the student`s work, which relate to a baseline model of control variables for further analysis, are presented in the form of descriptions, templates and graphs.

Department of Marketing

Counterfeit Consumption II

Advisor: *DALTON Amy N / MARK*
Student: *QIU Lan / SBM*
(UROP Course: UROP1000, Summer 2013)

Counterfeit consumption is a worldwide problem, not only for brand owners but also industries, consumers and countries. It is impossible to estimate the loss generated by counterfeiting. This project aims to understand consumers' motivation to buy counterfeits, especially under scarcity. As little attention has been paid to examining the relationship between scarcity and counterfeit consumption, I investigate from the perspective of people's motivational orientation (promotion vs. prevention focus). Around 200 students will be invited to complete a questionnaire about their choices between genuine and counterfeit products in either scarcity or control conditions. The proposed result is expected to show that prevention-focused people are more likely to buy counterfeit products than promotion-focused people, because the former are more concerned about the financial loss behind the product and the latter are more concerned with personal gain.

Keywords – Consumer behavior; decision making; counterfeit consumption; resource scarcity; regulatory focus

Advisor: *DALTON Amy N / MARK*
Student: *YAU Yuen San / ACCT*
(UROP Course: UROP1000, Summer 2013)

This project examines how scarcity under recession affects the consumption of counterfeit products. Specifically, it focuses on the psychological influence that affective job insecurity caused by recession has on behavioral changes in counterfeit consumption. We hypothesize that the affective job insecurity can be divided into: 1) cognitive job insecurity, 2) labor market insecurity and 3) income insecurity while increasing affective job insecurity results in a surging need for signaling in the labor market which, in turn, prompts the rampant consumption of counterfeits. Meanwhile, workers' income insecurity also plays a role in counterfeit consumption.

Consumer Greed

Advisor: *MUKHOPADHYAY Anirban / MARK*
Student: *CHOW Po Kei Prudence / GBUS*
(UROP Course: UROP1100, Summer 2013)
HUBER Benjamin / MARK
(UROP Course: UROP1000, Summer 2013)

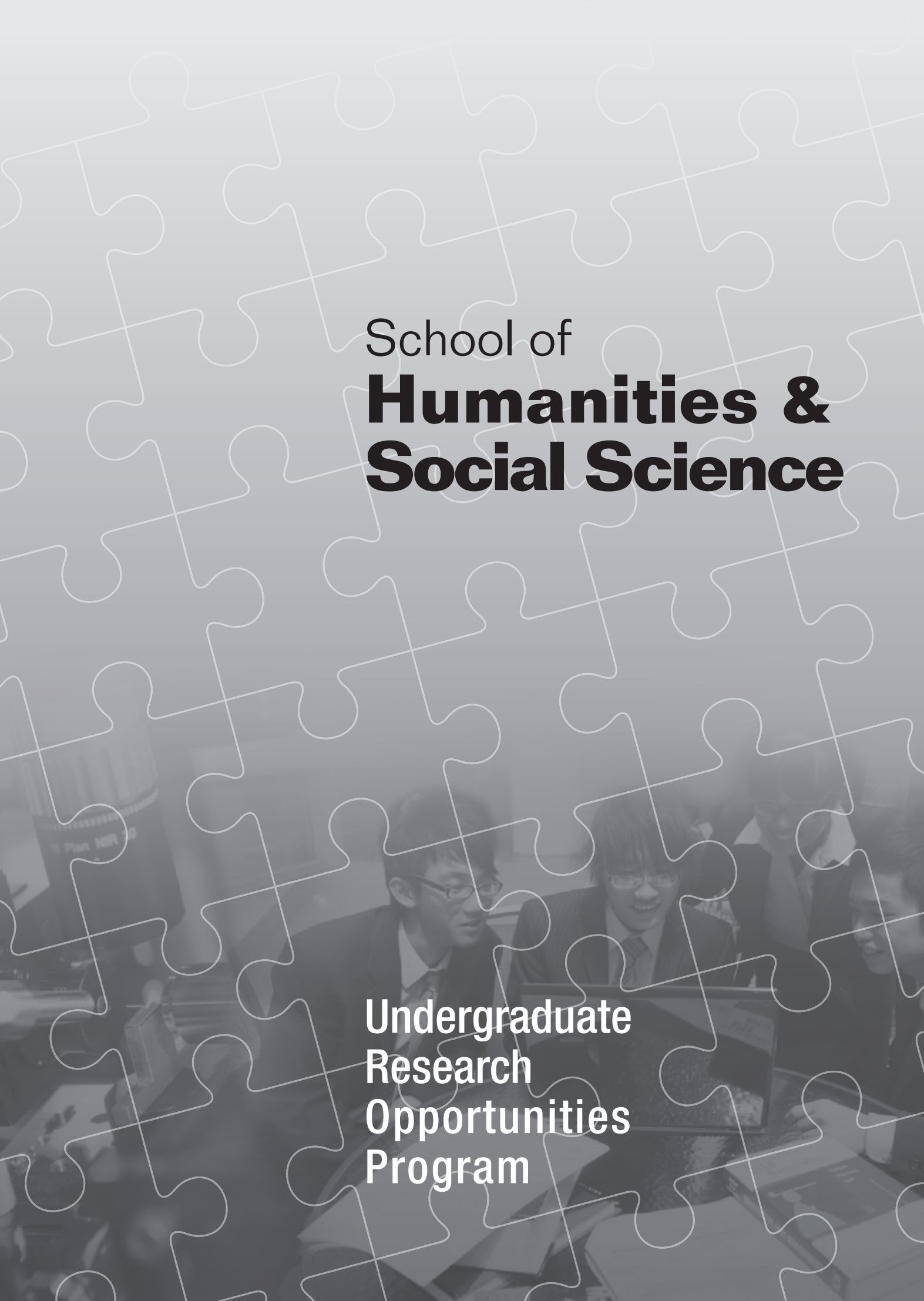
Packaging and nutrition labels for food products have a substantial psychological effect on consumers. Different attributes of packaged food such as the color, shape and imagery are used by marketers to illicit particular beliefs in consumers about the product. The recent implantation of mandatory nutrition labeling for packaged food products has been a topic of scrutiny among consumer psychologists. This project provides a theoretical development regarding three related categories: nutrition labels, packaging and lay beliefs on taste and healthiness. Ultimately, a hypothesis is reached regarding the behavior of consumers with opposite lay beliefs who are given chocolate packaged in light and dark colors with healthy and unhealthy nutrition labels.

Advisor: *MUKHOPADHYAY Anirban / MARK*
Student: *TANG King Tsz / ACCT*
(UROP Courses: UROP1200, Fall 2012;
UROP1300, Spring 2013)

Following the previous study, which found that low greed individuals exhibit greedier behavior in familiar conditions than their counterparts in unfamiliar conditions, this project seeks to replicate the results and further investigate what exact factors prompt familiarity in the interaction. The resulting explanation is based on an application of planned behavior theory coupled with the realization that the greed measurements used were mixed with social elements.

School of

Humanities & Social Science



Undergraduate Research Opportunities Program

Division of Humanities

Korean War Prisoners Oral History Interview Transcription

Advisor: *CHANG David Cheng / HUMA*
Student: *LIU Yishan / CENG*
(UROP Course: UROP1100, Summer 2013)

In this project, I transcribe the audio recordings of several oral history interviews conducted by Professor Chang among POWs in the Korean War. The interviewees talked about their lives before the war, how they entered the war and what they experienced in the prisoner camps. In addition, I read the memoirs composed by several POWs, who eventually went back to mainland China. These memoirs vividly depict the difficulties POWs encountered in the prisoner camps. Professor Chang's dissertation also provides comprehensive information. I was shocked by what actually happened to these returned prisoners in that era. This project provides me with the precious opportunity to look at history thorugh original sources, allowing me to focus on how these remarkable historical events affected individuals' lives.

Twentieth Century China in Photographs

Advisor: *CHANG David Cheng / HUMA*
Student: *LI Kang / CIGBM*
(UROP Course: UROP1100, Summer 2013)

This project involves collecting photos of China in the early twentieth century to discover how the country used to be. My report focuses on two themes: the Chinese Nationalist Army and traditional Chinese architecture. For the army pictures, I have collected photos taken mostly during the War of Resistance (1937-1945) and the Civil War between the Chinese Communist Party (CCP) and the Chinese Nationalist Party (KMT). Previously, I had little access to information or pictures of the Nationalist army, and little idea of what China was like during the early twentieth century. Thus, seeing the photos and sorting them according to time and photographer has given me a much better understanding of the KMT. More importantly, I have built a small photo archive in which the photos are sorted according to chronology or photographer. It will be useful in future studies as a reference, because these photos correspond to particular historical incidents.

In the final report, I first explain my research method and sources, then I analyze several sample photos to demonstrate what I have learned from the research process. I then summarize the research results.

Literati Painting in the Twentieth Century

Advisor: *FU Flora L T / HUMA*
Student: *CHEN Xiao / MARK*
(UROP Courses: UROP1100, Fall 2012;
UROP1200, Spring 2013;
UROP1300, Summer 2013)

It is unlikely that any modern Chinese artist could exhibit more proliferated artistic creation than Huang Binhong (1865-1955). Huang's 92-year life is widely regarded as an epic composed of thousands of splendorous landscape paintings. In reviewing Huang's artistic innovation, one may find that his style evolved slowly in youth and middle age, suggesting a self-determined learning process driven by calm patience. His early paintings are copies of those created by diverse ancient artist models from the early Song to the late Qing dynasties, indicating his appreciation for and eagerness to experience the best of the Chinese tradition. Works during his formative years bear relatively antiquarian scholarly characteristics, expressing a sense of refinement, transparency and tranquility. Not until he arrived at the final period of metamorphosis into his seemingly chaotic landscape paintings do we witness the ultimate expression of his personality.

Division of Social Science

International Organizations in the International Political Economy

Advisor: *CHO Hye Jee / SOSC*
Student: *LI Yongzheng / GCS*
(UROP Course: UROP1100, Summer 2013)

Cyprus, located east of Greece, south of Turkey, west of Syria and Lebanon and north of Egypt, has drawn the world's attention with its national economic crisis. Facing the unprecedented predicament originating from its oversized banks and other economic and political issues, Cyprus sought help from the International Monetary Fund (IMF) and was approved for a €1 billion arrangement under the Extended Fund Facility. The IMF focused on dealing with the two problem banks and fully protecting insured deposits in all banks [1]. This project explores the reasons for Cyprus's economic crisis, analyzes the current situation and discusses the prospects of Cyprus's future.

Advisor: *CHO Hye Jee / SOSC*
Student: *SHAO Jiaqi / ECOF*
(UROP Course: UROP1100, Summer 2013)

The 1997 Asian financial crisis had a dramatic effect on the countries involved. In the International Monetary Fund (IMF)-supported policy designs, financial reforms with complementary corporate sector reforms played the major role. The responsiveness to the crisis in South Korea outpaced that directed at Thailand, and political factors such as business-government relations and decision-making structures contributed to the different speeds and effectiveness of financial reforms and corporate restructuring processes. In Thailand, a weak coalition government with politicians who had direct interests in the insolvent institutions proved slow in reaction when the crisis struck, and had difficulty formulating a coherent response later in the corporate sector restructuring. In contrast, in South Korea, Kim Dae Jung exploited the crisis to push through wide-ranging reform legislation. The creation of the Financial Supervisory Commission facilitated the restructuring process, resulting in swift and effective policy responses.

Political Economy of Foreign Investment and Income Inequality

Advisor: *CHO Hye Jee / SOSC*
Student: *HERMANEK Stefan Johannes / GBUS*
(UROP Course: UROP1100, Fall 2012)

How are different forms of foreign investment affected by policy and political stability in respective host countries? When businesses decide to invest abroad, considerations about both stabilities are present in the process of weighing the potential benefits of foreign direct investments. Different views on the effects of policy stability and political stability indicate that investors consider a large number of factors in their decision-making process. This project hypothesizes that anticipated changes in the two stabilities influence the level of foreign investment. By discussing the cases of foreign direct investment (FDI) to Africa, Thailand and China, these hypotheses can neither be conclusively rejected nor accepted, prompting further research.

China/Africa Links Project

Advisor: *SAUTMAN Barry V / SOSC*
Student: *AU Ka Yi / GCS*
(UROP Course: UROP1000, Summer 2013)

This project discusses three themes. The first is the issue of localization, in which the Chinese are accused of constituting an overwhelmingly large proportion of the total work force in the construction and mining sectors of African states, depriving the Africans of the much needed job opportunities and thereby hindering their development. However, on gathering evidence from interviews with local subjects and checking the information against the policies of the Chinese companies, the facts indicate otherwise; that is, the Chinese are involved in technology and knowledge transfer in African countries, especially in the Sudan. The second issue is labor efficiency. Chinese interviewees have repeatedly claimed that Zambians work painfully slow, whereas Zambian interviewees think the Chinese work too hard. The third and final theme is mutual perceptions; that is, how the Chinese see the Africans and vice versa. The Africans respect the Chinese on the one hand and call them ‘boss’, but they also dislike the Chinese because they are too ‘rude’. On the other hand, the Chinese regard the Africans more one-sidedly in a negative light. Stealing is a common practice among the African workers, and the Chinese see them as irresponsible in the sense that they do not go to work as long as they have enough money. In this project, each of these themes is discussed in more detail.

Advisor: *SAUTMAN Barry V / SOSC*
Student: *XIA Mengyao / GCS*
(UROP Course: UROP1000, Summer 2013)

The negative Western stereotypes about lazy Africans are omnipresent and long-standing. The accusation is based on their refusal to supply plantation labor and related colonial economic activity. In contrast, based on the fact that the urgency of diligence is stamped with the brand of underdevelopment and socialism in China's history, the Chinese concept of laziness is apparently regarded as an obstacle to further progress. The image develops as a result of the inertia of the protracted customs of local people and Chinese misconception and it is biased because some Zambian workers actually aspire to succeed. The lazy African stereotype is problematic and more observation and investigation are needed to determine how to dismantle it.

Hong Kong Government and Politics

Advisor: *SING Ming / SOSC*
Student: *CHAN Pak Lam / GBUS*
(UROP Course: UROP1000, Summer 2013)

This project uses the 2013 Hong Kong Dock Strike (the Strike) to reveal and investigate several political issues including outdated labor and competition laws, economic inequality and crony capitalism. Hong Kong's situation will also be compared with those of other countries. First, I look at the background and causes of the Strike, then at the problems underlying these causes. Finally, I determine the political implications and consequences of the Strike in Hong Kong. A detailed timeline can be found in the Appendix, which lists significant events that happened during the Strike among the key parties involved.

Advisor: *SING Ming / SOSC*
Student: *CHEUNG On Wa / GCS*
(UROP Course: UROP1000, Summer 2013)

In this project, I reveal the factors that shape the governance of Hong Kong by unfolding the multiple dimensions of Hong Kong's political system, culture and dynamics before and after its handover. Throughout the research process, I investigate various issues, such as Hong Kong/mainland bilateral trading, Hong Kong/mainland conflicts and various acts discussed in the Legislative Council.

I first present my research findings on Hong Kong/mainland bilateral trading and conflicts, and briefly analyze the characteristics of both issues. I examine the Legislative Council by evaluating the voting results for particular acts and revealing their implications. I use the voting results to analyze the limitations of the current voting system, and how these limitations influence the voting results of the discussed acts.

Keywords: core value, voting system, bilateral trading, Hong Kong-ainland conflicts.

Advisor: *SING Ming / SOSC*
Student: *LEE Ka Wai / GBUS*
(UROP Courses: UROP1100, Fall 2012;
UROP1200, Spring 2013)

Movements against National Education led by the Civil Alliance have shown that Hong Kong's social movements have entered a new era. Over time, moving away from the demolition of the old Central Star Ferry Pier clock tower, this era has developed certain characteristics; namely, the active participation of the post-90-year-old generation and middle-class parents. The unprecedented level of participation from these two parties has changed history. Given the diverse and abundant human resources within the Alliance, their tactics are evolving and becoming more diverse, contributing to the partial victory of such Movements.

This rising tide of social movements has important implications for the protection of core values upheld by Hong Kong people. Hence, the determination to ensure the success of social movements in general is important to the well-being of Hong Kong citizens.

With certain modifications, this project applies a framework inspired by the book "Why Civil Resistance Works: The Strategic Logic of Nonviolent Conflict" by Erica Chenoweth and Maria J. Stephan. It will enable us to analyze and summarize how the outcomes of these social movements will be determined in the Hong Kong context.

Advisor: *SING Ming / SOSC*
Student: *LI Junde / MAEC*
(UROP Course: UROP1000, Summer 2013)

This project explains Hong Kong's importance in China's development by exploring the nature and size of the economic benefits mainland China derives from Hong Kong, now and in the long run. Despite the mainland's growing political and economic influence over Hong Kong, the latter's importance has continued to increase due to its position as an international financial center through the implementation of RMB internationalization and financial transition and opening.

Advisor: *SING Ming / SOSC*
Student: *MAN Yan Lok / BIOL*
(UROP Course: UROP1000, Summer 2013)

Freedom of speech is essential for every society to ensure that citizens to receive reliable information and have the right to express their views on different issues. However, the public worries about the suppression of press freedom by the government – its existence and degree, and the possibility that it might increase. This project examines cases belonging to two major areas, police and governmental intervention. All of the cases reviewed suggest that the government has used various channels to suppress press freedom, and that the methods are becoming more direct.

Advisor: *SING Ming / SOSC*
Student: *WAI Tin Ying / GCS*
(UROP Course: UROP1000, Summer 2013)

In this project, I explore the government and politics in Hong Kong, including an analysis of the issue of filibusters in Legislative Council and the topic of the excessive use of police force in Hong Kong. First, I examine three filibuster cases that occurred in Hong Kong in the past 1.5 years and analyze the interaction between the cutting off of a filibuster and legislative independence. Then, I discuss the issue of excessive police force in Hong Kong using different case studies.

Environmentally Friendly Attitudes and Behavior

Advisor: *TAM Kevin K P / SOSC*
Student: *BAI Site / CIBGM*
(UROP Course: UROP1100, Summer 2013)

In this project, we analyze how individual personalities, personalities at the country level (some of which are aggregated from the individual level) and different social axioms influence people's attitudes on pro-environmental behavior. The data sets used for environment-related variables include the World Value Survey, the European Barometer Survey, etc. We extract the data of different countries from sources such as the National Character Perception of Big Five Personality, Globe Project, Social Axioms, etc. The methods we use include literature review, zero-order correlation analysis and cross-level interactions analysis. We prove that some of our hypotheses cannot be supported by the results while others could and thus require further study. I elaborate on my research process through the influence of personality traits and the influence of social axioms on pro-environmental behavior and attitudes, respectively.

Advisor: *TAM Kevin K P / SOSC*
Student: *SO Hei Yu Helen / MGMT*
(UROP Course: UROP1100, Fall 2012)

Our project addresses the psychological processes and factors that affect people's environmental attitudes and behavior. We dive into the disciplines of environmental, communications and health theories when reviewing the concepts and literature to define the research question.

Our initial literature review incorporated topics including efficacy, perceived consumer effectiveness, trust, message framing, threat appraisal, learned helplessness, compassion fatigue and use of exemplars. The research was further narrowed by examining the effects of different ways of presenting exemplars (messages) on the receiver's efficacy involvement and attitude toward climate change. We then evaluate people's motivation when engaging in pro-environmental behavior. The elements of exemplars are manipulated, such as the number of victims, use of personal versus statistical representation and narrative stories.

How Do People Know What is Normative and Popular?

Advisor: *TAM Kevin K P / SOSC*
Student: *CHAN Chung Yin / FINA*
(UROP Courses: UROP1200, Fall 2012;
UROP1300, Spring 2013)

In this project, we continue to investigate how people seek informants and construct norms when preparing to enter new organizational cultures or discuss unfamiliar topics. Through an open-ended questionnaire, we focus on the cultural norm dimensions with which people are most concerned and the channels through which they receive informants. We attempt to set a scheme and quote the responses for initial analysis in addition to designing experiments to test the two hypothesized pathways by which people perceive the norms and social attributes of representative people or institutions.

Advisor: *TAM Kevin K P / SOSC*
Student: *CHOW Cheuk Him / BIOL*
(UROP Course: UROP1200, Spring 2013)

In this project, we continue to study the normative perception of people in general by analyzing the data collected last semester. We decode the raw data into meaningful categories and form a scheme for methods of cultural adaptation. Our focus then shifts back to the experimental procedures to investigate the effects of people's or community traits on the perception of norms when information is limited.

Advisor: *TAM Kevin K P / SOSC*
Student: *YU Ho Wing / MARK*
(UROP Courses: UROP1100, Fall 2012;
UROP1200, Spring 2013)

Humans are social animals whose behavior and decision-making processes are influenced by social norms. According to the previous study, people usually identify with the normative and popular if it might help them integrate into a new cultural environment. Therefore, the ways in which these people would prepare and the methods by which they would equip themselves are key factors to understanding their attempts to adapt to the new culture. The survey revealed that human's perceived nature is the answer. Due to a mental shortcut, people tend to believe in some people's words, perceiving what they say and how they behave as social norms. Analysis and discussion reveal several characteristics of these normative 'spokespeople': perceived accountability, perceived representativeness and perceived persuasiveness.

In this report, I discuss the study on cultural learning in both scenarios – country and company – followed by coding and further experimentation. Finally, I reflect on the process of conducting this research and how it informs further study.

Psychology of Emotion

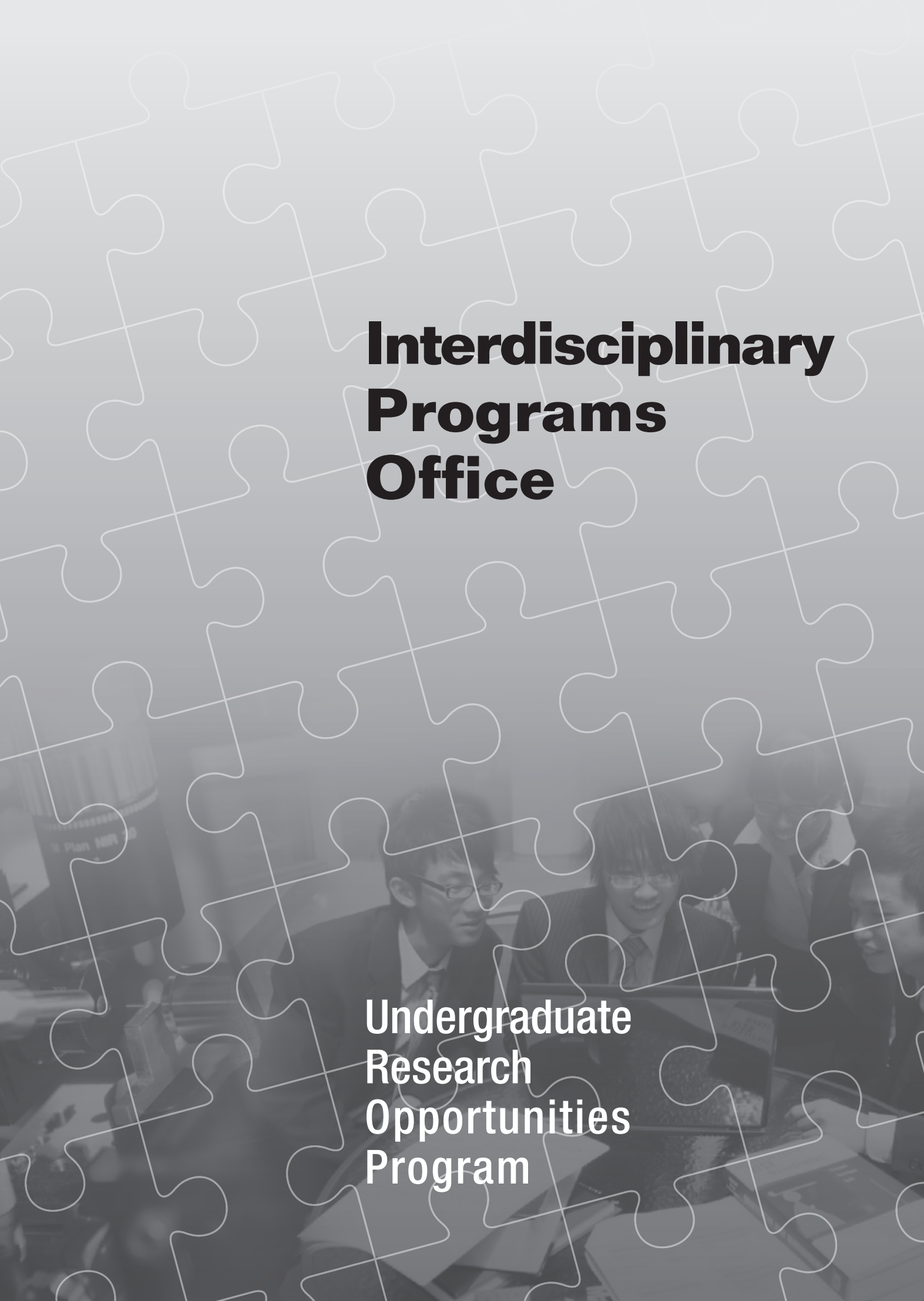
Advisor: *YIK Michelle / SOSC*
Student: *CHEN Ziyan / ECON*
(UROP Courses: UROP1200, Fall 2012;
UROP1300, Summer 2013)

The literature suggests that somatization tends to occur among people who are more acculturated to the Chinese culture. However, recent studies on the relationship between acculturation to the Chinese culture and somatization reached contradictory conclusions, with one reporting a significant positive correlation and the other no correlation. The present study explored the phenomenon of somatization among Hong Kong Chinese (*N* = 82) and the Mainland Chinese (*N* = 70) undergraduate students. Results showed that the more acculturated (to the Chinese culture) Mainland Chinese students used significantly more emotion words in describing their experience and feelings in a recent illness episode than did the less acculturated Hong Kong Chinese students. The latter used more somatic-emotion words. Future research should be conducted to further explore the interplay between somatization and other psychological conditions.

Advisor: *YIK Michelle / SOSC*
Student: *YIP Yuen Ting / COMP*
(UROP Courses: UROP1200, Fall 2012;
UROP1300, Spring 2013)

With the rapid advancement of technology, cyber bullying has emerged as a new form of bullying. In the present study, I examined the characteristics of cyber victims and compared their victimization at school and in the virtual space. In a sample of 224 (40% female) undergraduate students, victimization was found to have meaningful correlations with personality and affect variables. Neuroticism was positively correlated with victimization on the cyberspace and at school; extraversion was positively correlated with cyber victimization; and conscientiousness was negatively correlated with victimization at school. Future studies should be conducted to map out the relationships among different forms of bullying and other personality and emotion variables.

Interdisciplinary Programs Office



Undergraduate Research Opportunities Program

Functional Magnetic Resonance Imaging of the Rat Central Nervous System

Advisor: *LAU Condon / BME*
Student: *YEUNG Yuen Yee / SSCI*
(UROP Course: UROP1000, Summer 2013)

In this project, functional magnetic resonance imaging is used to study brain activity patterns as observed in rat models during exposure to different patterns of external stimulation. In the experiment, functional magnetic resonance imaging is involved in presenting designed stimulation to the rat models and magnetic resonance imaging is responsible for recording the signal changes in the brains of the rat models, which are correlated with the stimulation. The regions of signal changes reflected on the magnetic resonance imaging images represent the regions of the brain responsible for processing the particular stimulus. After identifying such regions, further data analysis and processing can be conducted.

Metal Recovery from E-waste

Advisor: *LAM Koon Fung / ENVR*
Co-advisor: *MCKAY Gordon / CBME*
Student: *DAIYAN Rahman / MECH*
(UROP Course: UROP1100, Spring 2013)

Rare earth metals are widely used in many industries ranging from everyday electronics such as compact fluorescent lamps to catalytic converters in vehicles. Incorrectly named, rare earth metals are quite abundant in nature, but they are extremely difficult to extract from their ore, and thus they command such high prices. The aim of this project is to evaluate a feasible process for recovering rare earth elements from waste phosphor recovered from compact fluorescent lamps. The major rare earth elements and their distribution are identified by material characterization techniques. The metals are then leached out using various solvents and the extraction efficiency is compared. Finally, a separation and purification technique will be developed to recover the elements in high purity.

Keywords – rare earth metals; material characterization; leaching; phosphor.

Selective Adsorption of Metal Ions

Advisor: *LAM Koon Fung / ENVR*
Co-advisor: *MCKAY Gordon / CBME*
Student: *ZHANG Jiabei / CBPE*
(UROP Course: UROP1100, Spring 2013)

Copper and cadmium are widely used in the electroplating industry, which also generates these metals in the wastewater. The existence of free copper in human blood causes toxicity because it generates reactive oxygen species such as superoxide, hydrogen peroxide and the hydroxyl radical, which damage proteins, lipids and DNA. The acute effects of copper poisoning include vomiting, hematemesis, hypotension, melen, coma, jaundice and gastrointestinal distress. The inhalation of cadmium-laden dust quickly leads to respiratory tract and kidney problems, and the chronic effects of both copper and cadmium exposure can damage the liver and kidneys. Due to the high toxicity of copper and cadmium, they pose a serious threat to the environment. Therefore, it is necessary to remove copper and cadmium from the wastewater to reduce the environmental impact. Currently, heavy metals can be removed from wastewater using several different techniques, including unit operations such as chemical precipitation, coagulation, complexation, ion exchange, solvent extraction, foam flotation, electrode position, cementation and membrane operations. Among these techniques, the most economical is chemical precipitation. However, the limitations of these removal methods include high operational costs, changes in pH, the presence of complexing agents, metallic fouling and no metal separation.

In addition, to conserving valuable natural resources, the recovery of copper and cadmium is needed for other reasons. Adsorption, as an effective and economical wastewater treatment process, can be used for the removal of heavy metals. In this process, a film of the adsorbate adheres to the surface of the adsorbent. Active carbon is the most widely used adsorbent due to its large micropore volume and the resulting high surface area.

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