LABCONNECT

GUIDEBOOK

CONTENT

INTRODUCTION

The Ministry of Science and Technology is a governmental agency which performs the function of state management of science and technology, covering:

- Scientific and technological activities
- Development of scientific and technological potential
- Intellectual property
- Standardization
- Measurement and quality control
- Atomic energy
- Radiation and nuclear safety
- State management of public services in the domains under its management in accordance with law.

The State Agency for Technology Innovation (SATI), one subordinate of MOST from 2007, functions as a bridge between academy and industry by strengthening and promoting technology applications and innovations. In particular, it facilitates the application of research results and technology from within and outside the country in production and business. SATI has the two-fold task both as the policy maker who proposes drafts and implements policies and the supporting body for technological innovations.

SATI also manages the National Technology Innovation Program. The duties include conducting surveys and assessments of technology applications and transfers as well as innovative activities. SATI has established a database for technological development follow-up. SATI promotes and monitors technological acquisitions and innovations and develops networks of technology incubators and technology transfer institutions. One of the main tasks is to stimulate investments to the sector and to integrate Vietnam to the international S&T market. SATI also provides consultation services and human capacity training. SATI is entitled to establishing new units, which can work according to business principles.

VEFFA INTRO

The Vietnam Education Foundation Fellows Association (VEFFA) is a non-profit professional organization established and run by fellows and scholars of the Vietnam Education Foundation (VEF). VEFFA has more than 300 members who have been studying, training, and working in research and development at the leading institutions (universities, laboratories, companies, etc) in the U.S. and over the world. VEFFA devotes to the professional development of its members through proactive participation in the promotion of the cooperation between Vietnam and the United States in education, science, and technology. Specifically, VEFFA aims to provide support for the members in realizing their highest professional potential and to contribute to building strong science and engineering communities in Vietnam who can promote the development of Vietnam and maintain scientific cooperation with the U.S.

LabConnect is a project run by VEFFA aims to foster the connections and collaborations between research laboratories and people of Vietnam and the U.S. The final outcome of the project is this book which provides detailed information and contacts of nearly 30 leading research laboratories in the U.S at which VEFFA members are working or training. The information here is valuable for Vietnamese researchers, practitioners, managers, and students to enhance their research vision, reach, and collaboration. In the next versions of the book, we plan to increase the number of presented laboratories, fields, and countries.

Acknowledgement

The work could not be done without contributions and support of many people. The project team gratefully thanks

- Vice Minister Le Dinh Tien, Vice Minister Chu Ngoc Anh of Vietnam Ministry of Science and Technology, and Dr. Tran Thanh Nam from Mobivi for their support in the preparation phase of the project.
- Dr. Nguyen Duc Hoang from State Agency for Technology Innovation of Ministry of Science and Technology of Vietnam for his support throughout all the phases of the project.
- The VNG Corporation and their designer team for their finance support and for helping to design the in-press version of the book.
- Hoa Trinh (UMich), Truong X. Nghiem (UPenn), Hoang Q. Nguyen (UMass), Giang D. Nguyen (UIUC), Tung M. Che (UIUC), and Nam Nguyen (UIUC) for their contributions in the setting up phase of the project.
- Giang D. Nguyen (UIUC), Nam Nguyen (UIUC), Tung M. Che (UIUC), Hung Ha (Case Western Reserve University), Anh Van (UIUC), Thu Vuong (Cornell University), Son Hoang (University of Texas at Austin), Anh Nguyen (University of Massachusetts at Amherst), Hoang Q. Nguyen (University of Massachusetts at Amhert), Liem Phan (University of Texas at Houston), Dung Nguyen (Northeastern University), and Cuong K. Nguyen (National Institute of Allergy and Infectious Diseases, National Institutes of Health), who have contributed their lab introduction and contacts in the initial phase of the project.

CỤC ỨNG DỤNG & PHÁT TRIỂN CÔNG NGHỆ

VEFFA

CHAPTER 2

ENGINEERING LABS

BRIDGING THE GAP LEVERAGE VIETNAM IN SCIENCE & TECHNOLOGY

IS IT ONLY THE SCIENCE AND TECHNOLOGY THAT REALLY MATTER FOR MANKIND?

Through ten thousands of years of mankind history people born and die wars come and go empires rise and fall the only things still last and grow are our skills and knowledge to Improve our lives, uplift ourselves above the other creatures.

FOREWORD

Significant advancement in Science and Technology in the last few decades have not only improved quality of life but also changed the demographic world map with the rising of new powerful high-tech nations like India, China, Korea and Taiwan. So where is Vietnam on that world map? Are we visible to the world?

Recently, Vietnam has realized the importance of Science and Technology (S&T) to seize the opportunity to uplift the country. It has been actively making investment, sending people abroad, looking for collaborations to learn how to improve S&T condition in Vietnam. This "Lab connection guidebook" project is created to join that effort. With more than 300 Masters, PhDs, and Post-docs working in research laboratories at top universities around the United States, the Vietnam Education Foundation Fellows Association (VEFFA) is a great resource for potential collaborations between Vietnam and US. Everyday, those researchers have the opportunities to expose directly to advanced technologies, and work closely with world class experts. They are potentially valuable facilitators of connections between interested parties from both Vietnam and U.S.

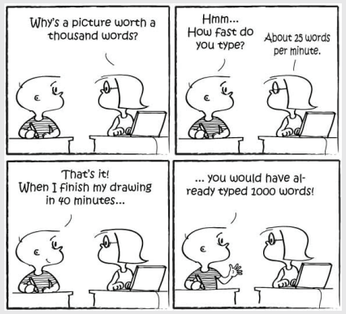
In this project, Vietnamese oversea researchers will introduce their research in focus i.e. the technology, their area of expertise, their projects, and examples of facilities used to conduct their research. This will help researchers and policy makers in Vietnam to update on new research frontiers, to gather information on active technologies at the early stage, to exchange expert knowledge from research directions to equipment usages, and more importantly to have contact points for further investigation and future collaborations. This project will also help those oversea researchers promote their research activities, update with situations at home to shape their career, and establish connections with future employers and collaborators. In the later stage of the project, research groups and laboratories in Vietnam can also share their research and interests in this guidebook.

This project is sponsored by State Agency for Technology Innovation (SATI), Vietnam Ministry of Science and Technology. SATI will be responsible for publishing and distributing this guidebook.

WAVES – WIRELESS AND VIDEO COMMUNICATION

SECURE THE FUTURE THROUGH RESEARCH AT THE FOREFRONT OF INNOVATION

Do you now that a picture is worth a thousand words?



The WAVES Lab - ECE
Michigan State University

The WAVES lab at Michigan State University are working at the state-of-the-art areas in image, signal processing and visual communications.

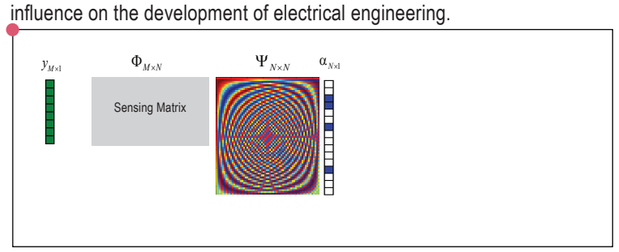
One important part of our research focuses on the source and channel coding. We investigate new paradigms in source coding and information theory for efficient representation of visual content. We take into consideration both the Internet and wireless segments of the end-to-end chain.

The other important part is the new communication approaches based on interactions among different layers of the protocol stack of wireless network. Efficient, programmable, and scalable solutions for the realization of multimedia applications in low-power, low-complexity, and distributed wireless mobile devices are being investigated.

Some of our research work is in collaboration with leading imaging companies such as Kodak Research Labs and Technicolor. Other projects are being funded by the National Science Foundation (NSF).

COMPRESSED SENSING

Compressed sensing (also known as compressive sensing, compressive sampling or sparse sampling) is a technique in algebra and has a strong influence on the development of electrical engineering.



Our research exploit the emerging field of compressed sensing to solve many different problems in audio and image processing. The application is such that in color filter array of camera, video denoising and video supper-resolution.

WIRELESS NETWORK

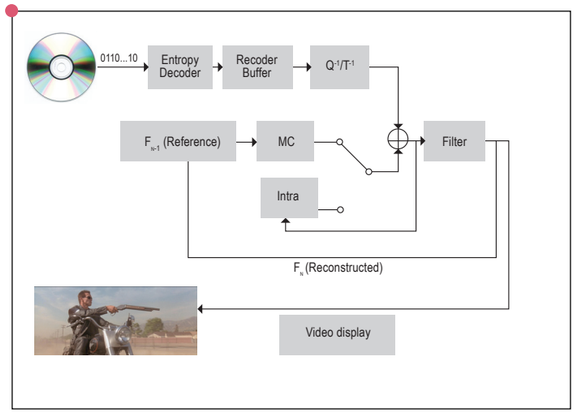
In wireless network, our research problems are emerging from the convergence of three technology areas: wireless networks, the Internet, and multimedia communications. We focus on the transmission of high-quality and scalable video over new generations of wireless Internet and mobile networks. These networks include:

- The wide range of wireless Local-Area-Networks (LANs).
- Mobile and cellular networks.
- Ad-hoc mobile networks.

Currently, we are working with Social Network Services with millions and even billions of users to have a deeper understanding of structure of social networks and how that structure evolves can be applied to a variety of social issues.

VIDEO COMPRESSION

The amount of video being processed is increasing rapidly, for example, over 48 hours of new videos are uploaded to the YouTube site every minute. The demand for high quality of video is also higher and higher. We need to develop a better video compression standard.
Our primary objective is to focus on improving H.264 Advance Video Compression which is an essential technology for applications such as digital television, DVD and Blu-Ray disks, mobile TV, videoconferencing and internet video streaming.



Chinh T Dang, Email: trungchinh87@gmail.com or dangchin@egr.msu.edu, Phone: (001) 517-348-9036

HANK VIRTUAL ENVIRONMENTS LAB

The Hank Virtual Environments Lab focuses on using virtual environments to study human perception and action. There are two main foci of this research program. One is understanding how children and adults negotiate traffic-filled intersections in our virtual environment The other is understanding how people perceive and adapt to virtual environments. The overarching goal of this multidisciplinary project is to advance the fields of behavioral science and computer science through our study of human behavior in real and virtual environments.

PERCEPTION AND ADAPTATION RESEAR

Virtual environments have gained widespread use in recent years as a tool for studying human behavior. Problems ranging from how children make road-crossing decisions to how adults respond to social situations have been studied using various kinds of immersive virtual environments. Virtual environments have also been used as a tool for training new skills, particularly in cases where training in the real environment can be risky or dangerous. Given the growing use of virtual environments for research and training purposes, we are interested in understanding more about how people perceive and adapt to virtual environments. Broadly speaking, our work focuses on how experience in real and virtual environments affects how people perceive distance.

SECURE THE FUTURE THROUGH RESEARCH AT THE FOREFRONT OF INNOVATION

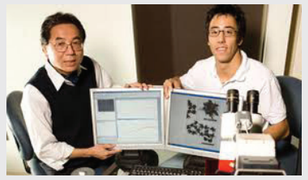
BICYCLING SIMULATOR RESEARCH

The bicycling simulator provides a unique resource for investigating how children and adults negotiate traffic-filled roadways.

Bicycling injuries represent a significant public health problem in the United States. Five-to -15-year-old children represent a particularly vulnerable segment of the population, having the highest rate of injury per million cycling trips. Motor vehicles are involved in approximately one-third of all bicycle-related brain injuries and in 90% of all fatalities resulting from bicycle crashes. Many of these collisions between bicycles and motor vehicles occur at intersections. A critical first step in developing programs to prevent these car-bicycle collisions is understanding more about why such collisions occur. Our work uses virtual environment technology to examine the factors that may put children at risk for car-bicycle collisions when crossing intersections.

Dat Tien Nguyen, 311 MLH, Iowa City, IA 52242

VO DINH RESEARCH GROUP - AT THE FRONTIER OF NANOBIOTECHNOLOGY



In the Duke experiments, the nanostars were used in conjunction with a phenomena first described in the 1970s known as surface enhanced Raman scattering (SERS). When light, usually from a laser, is shined on a sample, the target molecule vibrates and scatters back its own unique light, often referred to as the Raman scatter. However, this Raman response is extremely weak. When the target molecule is coupled with a metal nanoparticle or nanostructure, the Raman response is greatly enhanced by the SERS effect – often by more than a million times, Vo-Dinh said.

INTRODUCTION

The Vo-Dinh Lab is focusing on NanoBioTechnology studies including:

- Biosensors for biomedical applications
- Biochips for the detection of diseases at the point-of-care, and for global health applications
- Laser-Induced Fluorescence for Rapid Cancer Diagnosis
- RAMan Integrated Tunable Sensor (RAMITS) for Automated Chemical Identification in the Field.

BIOSENSORS

Biological Probes

A new generation of biosensors are being developed, which combine the sensitivity of laser excitation, the versatility of fiberoptics, the low cost of microelectronics, and the specificity of bioreceptor probes:

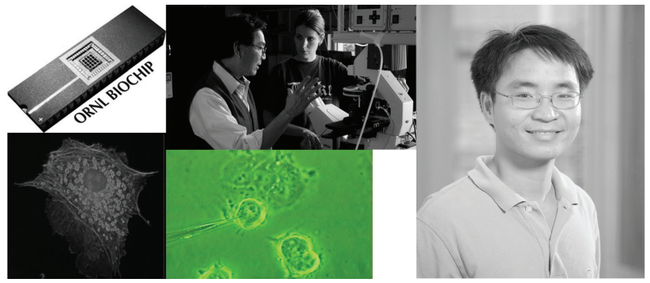
- Antibody-based biosensors
- Gene probes for "Designer Biochips"
- Synthetic bioprobes

Advanced Bioinstrumentation

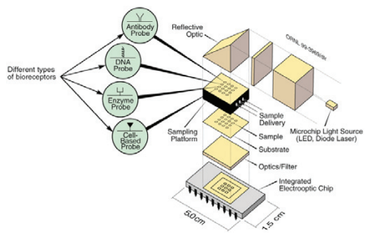
Laser-based spectroscopies developed for ultrasensitive detection of biological species (DNA, proteins, biomarkers, etc.) using:

- Laser Synchronous Luminescence
- Surface-Enhanced Raman Scattering (SERS)
- Nanotechnology for submicron fiberoptic biosensors
- Micro-electrooptics, waveguide technology and biological probes are integrated for biosensor development

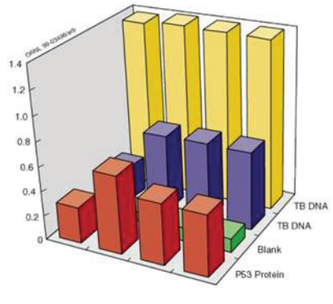
SECURE THE FUTURE THROUGH RESEARCH AT THE FOREFRONT OF INNOVATION



The combination of biotechnology, integrated circuit (IC) technology, and microfabrication techniques has led to the development of a novel integrated multifunctional biochip (MFB), which allows simultaneous detection of several disease end-points using different bioreceptors (such as DNA, antibodies, enzymes, and cellular probes) on a single biochip system.

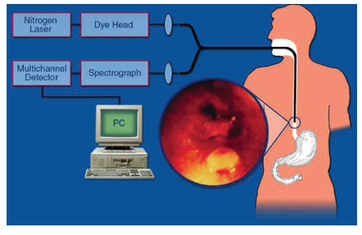


Schematic diagram of a Biochip system



The MFB used for simultaneous detection of the p53 protein (antibody probe) and the Microbacterium tuberculosis gene (DNA probe)

A battery-operated, field-portable Raman instrument has been developed by scientists and engineers at Duke University and Oak Ridge National Laboratory (ORNL) for the automated identification of hazardous materials. Using this instrument, it is possible to detect the vibrational signature of the chemical species that are present. Based upon this chemical signature, an automated chemical identification can be performed within seconds.



RAMAN INTEGRATED TUNABLE SENSOR (RAMITS)

A minimally invasive method using laser-induced fluorescence (LIF) for in vivo cancer diagnosis has been developed by scientists at Duke University, Oak Ridge National Laboratory (ORNL), and the Thompson Cancer Survival Center (TCSC).

Hoan Ngo, PhD Student in Biomedical Engineering at Duke University, Durham, North Carolina, USA; VEF Fellow – Cohort 2011, Cell phone: 919-638-4988; Email: hoan.ngo@duke.edu

SIGNAL PROCESSING FOR MEMS SENSOR ARRAY

What we can sense limits
what we can understand.
The future Internet will
expand our
sensing capability by
connecting the virtual world
to the physical world.
A new wave of opportunities are coming.
Are we ready?!?

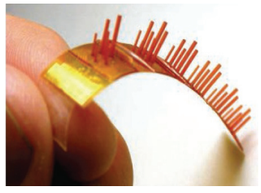
DID YOU KNOW?
The success of the iPhones boosted the market of MEMS accelerometers for smart phones to $1.3 billion by 2012

TECHNOLOGY AND APPLICATIONS

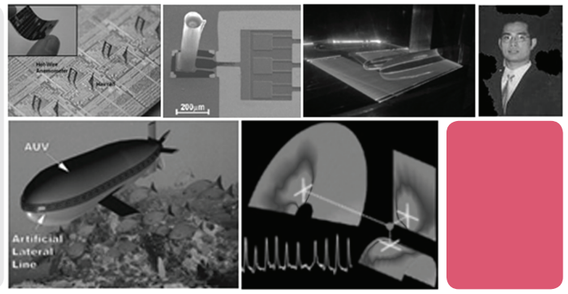
The recent advancement in Micro-Electro-Mechanical Systems (MEMS) technology has introduced a new class of very small machines at the micro-scale. MEMS technology is actually available in many commercial products such as MEMS accelerometers in iPhones and car airbags, MEMS mirror in Internet optical switches and DLP projectors, MEMS gyroscope in cars, and MEMS piezoelectrics in inkjet printers. The full impact of this technology is not yet realized as many research labs are exploring the use of it in different applications such as a medical device in blood vessels for drug delivery or hair-cell sensors on smart skin of robot arms. The MEMS technology also promises to revolutionize the sensing application category to enable a large scale sensor network to connect the physical world and expand the Internet to the next level.

RESEARCH LAB AND PROJECT

At the University of Illinois, a multi-million dollar and interdisciplinary project called BioSense was created to develop artificial MEMS hair-cell sensors similar to the ones used by fish (under its skin) to navigate and hunt in water. The sensors would greatly expand underwater imaging capacities beyond those now generated by sonar or cameras. The project involves research groups in different disciplines, including biologists to understand fish sensing behaviors, fluid mechanics to study physical environment constraints, MEMS researchers to make the sensors and signal processing team to process the data.



SECURE THE FUTURE THROUGH RESEARCH AT THE FOREFRONT OF INNOVATION



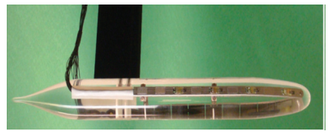
TECHNOLOGY AND APPLICATIONS

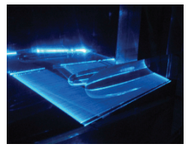
The role of our research group in this project is to create a signal processing algorithm to interpret the signals collected from sensors.

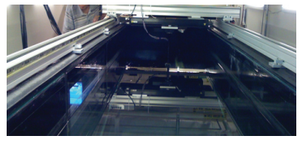
We work closely with the MEMS group, who makes the sensors, to build a testing submarine model to attach the sensors.

We use the Particle Image Velocimetry (PIV) system from Havard biology lab to study the fluid dynamic phenomenon impacting on the testing platform. The PIV system produces a sheet of laser beams in water mixed with small reflective particles. High speed cameras record the movements of the particles to compute the local flow velocity.

The whole system is tested in a 10 meter long water tank with advanced stage control system to drag the testing models in water at a constant speed. Signals from sensors are used to control another submarine to follow the leading submarine.



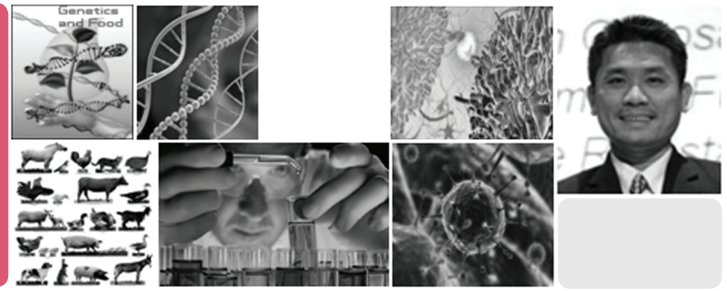




Nam Nguyen, 111 Coordinated Science Laboratory, University of Illinois, 1308 W. Main St, Urbana, IL 61801, USA Phone: 217-721-8750,
Email: nnguyen5@illinois.edu or namtheman77@gmail.com

NUTRIGENOMICS AND IMMUNONUTRITION

SECURE THE FUTURE THROUGH RESEARCH AT THE FOREFRONT OF INNOVATION



ABOUT THE RESEARCH AREA

WHAT DO WE KNOW ABOUT

- Nutrigenomics ?
- Immunonutrition ?
- Their interactions ?

WHAT ARE FUNCTIONAL INGREDIENTS?
WHAT DO THEY DO IN NURSERY PIGS?
IMPROVEMENTS IN

- Growth performance
- Immune function
- Disease resistance
- Health

And even more technology advances

KEY EQUIPMENT

- HPLC system
- DGGE system
- Animal facilities
- Fluorescence microscope
- ELISA plate reader
- Flow cytometry facilities
- Nanodrop spectrophotometer
- Bio-analyzer
- Real time PCR machine
- Affymetrix genechip system

SWINE NUTRITION AND HEALTH LABORATORY

The aim of the Lab is to study effects of functional ingredients on animal performance and health. We evaluate effects of functional ingredients in nursery pig diets on growth performance, gut health, gene expression, immune function, and disease resistance.

Implications: It increases our understanding of how nutrients impact the production of specific gene products and the functions of the immune system and how these proteins and the immune system affects the response to nutrients. Further, diets supplemented with functional ingredients may improve pig performance and disease resistance. Finally, it may also help develop functional foods to keep people healthy.

FUNCTIONAL INGREDIENTS?

"Functional ingredients may refer to ingredients that convey some health benefit above and beyond fulfilling basic nutrition".

Ingredients: Cereals, milk products, spray-dried plasma, zinc & copper, acids, yeast & yeast products (mannan oligosaccharide), egg immunoglobulins, direct-fed microbials, fructo oligosaccharide, herbs, spices, botanicals, and essential oils.

GASTROINTESITINAL TRACT HEALTH:

- Gut morphology & integrity
- IgA levels and antimicrobial molecules
- Microbial populations/Gastrointestinal environmen

GENE EXPRESSION:

- Local or systemic levels
- Specific genes or all genes
- Associated network functions/Functional pathway healthy.

IMMUNE FUNCTIONS:

- Immunological properties of functional ingredients
- Assay: proliferation, cytotoxicity, phagocytosis
- Immunoglobulins, cytokines, acute phase proteins, differential leukocyte counts, leukocyte subpopulations (CD4 or CD8 T cells)
- Injury of organs, presence of pathogens in tissues, bacteremia, and viremia

SOME PICTURES OF EQUIPMENTS

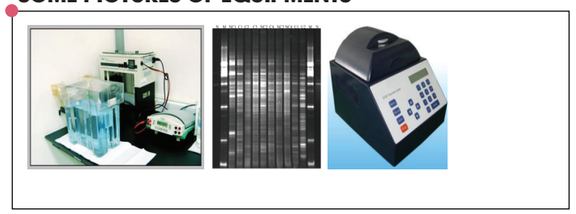


Figure 1: Denaturing gradient gel electrophoresis (DGGE) profiles of PCR-amplified 16S rDNA fragments from gastrointestinal bacteria.

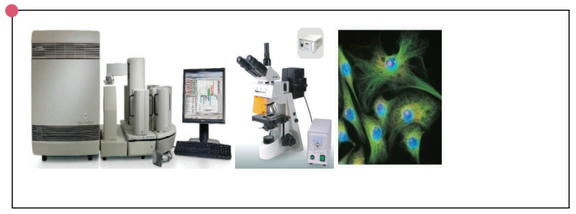


Figure 2: Taqman ABI 7900 real time PCR machine (left); a fluorescence microscope (middle); fluorescence microscope image of cells (right).

Figure 3: Affymetrix core facility (left); a genechip (middle); hybridization of tagged probes to Affymetrix Genechip microarray.

Tung M. Che, 208 Animal Sciences Laboratory, University of Illinois, 1207 W. Gregory Dr., Urbana, IL 61801, USA, Phone: 217-333-9749, Fax: 217-333-7861, Email: chetung2@illinois.edu or tungcheminh@yahoo.com

CORROSION SCIENCE AND ENGINEERING

Corrosion and degradation of infrastructure is a cancer to society

DID YOU KNOW?
The estimated annual direct cost of corrosion in the U.S in 2002 is 276 billion dollars, accounting for approximately 3.1% GDP

(source: NACE.org)

INTRODUCTION

Corrosion and degradation of infrastructure is a cancer to society. Aging infrastructure is not only a crisis of developed countries but also in developing ones.

Corrosion of metals and alloys costs trillions of dollars world wide and is the direct cause of many accidents such as bridge collapse or blast from a gas pipeline.

The performance and reliability of engineering structures is based largely on the corrosion resistance of the constituent materials.

CORROSION LABORATORY AT CWRU

The Materials Performance and Reliability program at CWRU addresses the need for:

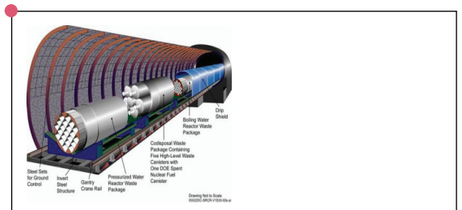
- Advanced risk assessment.
- Asset management and life prediction methodologies for reliability and safety.
- Accurate assessment of current status and reliable predictions of future performance.

The mission is met through science, technology and education initiatives to develop deterministic models for life prediction, multi-scale, coupled models from molecular/process level to full system performance, for educating the next generation of subject matter experts and for training leadership and technical managers in risk assessment and asset management for a sustainable future.

SECURE THE FUTURE THROUGH RESEARCH AT THE FOREFRONT OF INNOVATION

CORROSION OF SPENT NUCLEAR FUEL CANISTER

Management of spent nuclear fuel is one of the biggest challenges for the development of nuclear energy industry. Spent nuclear fuel is stored in containers and buried in geological repositories that should last for thousands of years. Corrosion of the container materials becomes a critical issue for the success of this project.



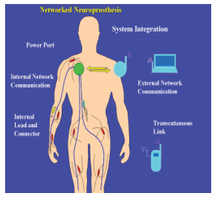
Spent nuclear fuel canister

CORROSION OF BIOMATERIALS

Implantable biomedical devices significant improve the quality of human life. Pacemakers, artificial hips, neuroprosthetic devices, etc. are saving lives and restoring functions for millions of patients.

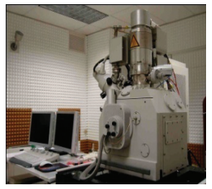
In vivo corrosion does not only reduce the useful lifetime and the reliability of these devices but also poses many risks due to the release of ions as the product of the corrosion process.

Understanding the corrosion process of existing materials and development of new corrosion resistant, biocompatible materials are important for the advancement of biomedical applications.



Networked Neuroprosthetic System

1.



2.

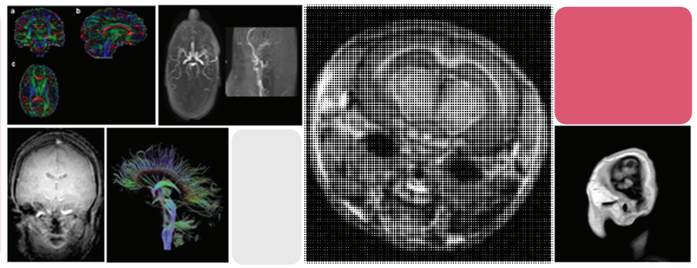
3.

1. 300kV energy-filtering high-resolution TEM Tecnai F30
2. Dual beam FIB system FEI xT Nova Nanolab 200
3. Scanning Auger Microprobe system Perkin-Elmer PHI 680

Hung Ha, Dept. of Materials Science and Engineering, Case Western Reserve University, 10900 Euclid Ave., Cleveland, OH 44106, USA
Phone: 216-212-4962, Email: hung.ha@case.edu or hungmha@gmail.com

MAGNETIC RESONANCE IMAGING FOR BIOMEDICAL APPLICATIONS

SECURE THE FUTURE THROUGH RESEARCH AT THE FOREFRONT OF INNOVATION



University of Illinois is home to the father of MRI, the Nobel prize laureate, Paul C. Lauterbur

DID YOU KNOW?
11.7 T is the human MRIscanner with the highest field strength till now

MAGNETIC RESONANCE IMAGING

Magnetic resonance imaging (MRI) is primarily a medical imaging technique most commonly used in radiology to visualize the internal structure and function of the body. MRI provides much greater contrast between the different soft tissues of the body making it especially useful in neurological (brain), musculoskeletal, cardiovascular, and oncological (cancer) imaging.

Research in MRI at University of Illinois ranges from physiological system modeling to technique development including image acquisition strategies, image reconstruction and extraction, and artifact correction to applications to diffusion and perfusion imaging, structural neuroimaging, functional neuroimaging, cardiac imaging, speech and swallowing.

The Magnetic Resonance Functional Imaging Laboratory (MRFIL) is located in the Bioengineering Department at the University of Illinois at Urbana-Champaign.

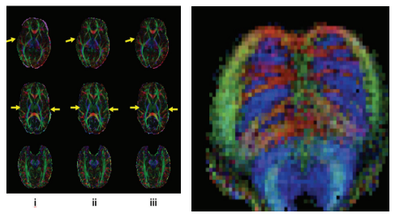
MRFIL focuses on the development of acquisition and image reconstruction strategies, using MRI, to accurately and quantitatively image physiology with primary applications in functional brain imaging, structural brain imaging, and neuromuscular dynamics during normal speech and swallowing. We are also interested in biomarkers associated with declines in cognitive and motor performance that come with healthy aging.

MRI SCANNERS

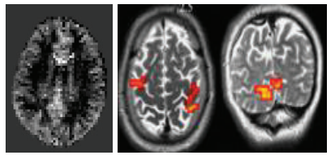
1. Siemens 3 T Allegra
2. Siemens 3 T Trio
3. Varian 14.1 T

EXAMPLE PROJECTS

High-resolution diffusion-weighted imaging for assessing white matter integrity and connectivity



Blood flow imaging for brain function detection.



Anh Van, 3251 Digital Computer Lab, University of Illinois, 1304 W. Springfield Ave, Urbana, IL 61801, USA, Phone: 217-333-2773,
Email: tvan2@illinois.edu

BIOFUELS RESEARCH

National security, the environment, and the marketplace remain important and consistent drivers for the development of biofuels in the United States

DID YOU KNOW?
The US and Brazil together account for more than 85% of the world's bioethanol production in 2008. Bioethanol is produced mainly from corn in the US and sugarcane in Brazil.

TECHNOLOGY AND ITS APPLICATION

Second and third generation biofuel technologies have been developed to manufacture biofuels from biomass, instead of food crops (sugarcane, corn and wheat) as in the production of the first generation bioethanol. These technologies extend the resources for biofuels; cellulosic biofuels can be sustainably produced from the non-food parts including stems and leaves of current crops, from non-food plants such as algae, switch grass and jatropha, as well as from industrial waste like wood chip and pulp.

Cornell University creates a suite of laboratories for research of biofuels from ligno- and cellulosic materials. One of these laboratories is the Biofuels Research Laboratory (BRL).

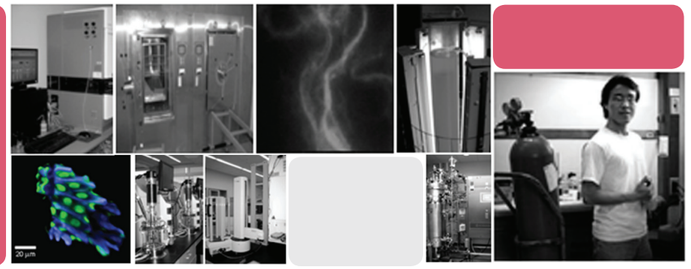
BIOFUELS RESEARCH LABORATORY

In 2008, the Cornell Biofuels Research Laboratory was funded by the Empire State Development Corporation in the amount of $10mil. with $6mil. allocated for construction of the laboratory and $4mil. for capital equipment.

The goals of the BRL are to:

- Expand biomass pretreatment research
- Expand research and development capacity for enzymatic conversion of cellulose to fermentable sugars
- Expand research and development capacity for the fermentation of mixed sugar streams
- Integrate pretreatment, enzymatic conversion, and mixed sugar fermentation around New York State energy crops

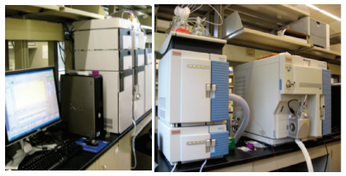
SECURE THE FUTURE THROUGH RESEARCH AT THE FOREFRONT OF INNOVATION



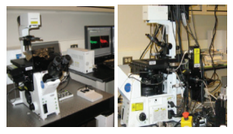
FACILITY AND EQUIPMENT

All images in this slide are from in the BRL (courtesy: BRL). Here is an example about equipment for studying and engineering cellulases to break down cellulose, one of the key components of plant cell walls.

BioFlo 310 and BioFlo Pro 150L fermentation systems to produce cellulases from ***Streptomyces***



Shimadzu High Pressure Liquid Chromatography (HPLC) and Gas Chromatography Mass Spectroscopy (GC-MS) systems to analyze products from cellulase assays



Olympus Confocal Microscope and Total Internal Reflection Fluorescence Microscope (TIRFM) to track the movement of fluorescence-labeled cellulases on cellulose chains

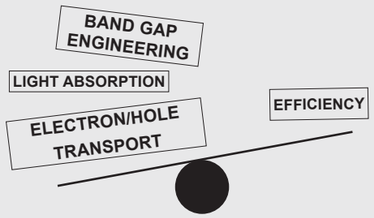
BioTek Plate Readers together with BioTek Robotic System and EpiMotion Robotic Platform to facilitate measurement of enzymatic assays

Thu Vuong, 460 Biotechnology Building, Cornell University, Ithaca, New York 14853, USA, Phone: 607-279-8033, Email: thu.vuong@veffa.org

SURFACE CHEMISTRY & PHOTOELECTROCATALYSTS

FOR WATER SPLITTING REACTION

HOW TO MAXIMIZE SOLAR-TO -HYDROGEN EFFICIENCY?



DID YOU KNOW?
The Sun radiates our planet with 105 TW

Global power consumption in 2001 was ~ 13.5 TW

Photocatalysts with long term stability and at least 10% efficiency is required for practical application

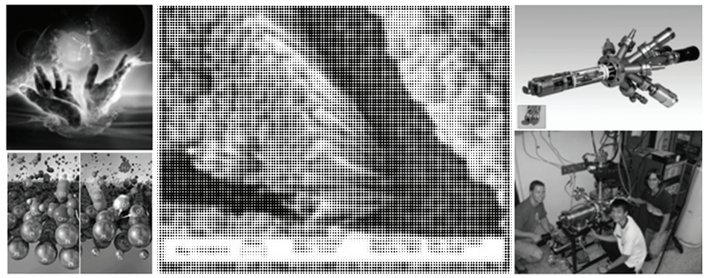
INTRODUCTION

Semi-conductors under appropriate solar irradiation generate electrons and holes which can split water into gaseous hydrogen and oxygen. The production of hydrogen from solar water splitting reaction has been termed a “Holy Grail” of chemistry.

As a research subgroup of the surface chemistry lab, the Photoelectrocatalyst team seeks to contribute knowledge regarding solar-irradiation driven water splitting photoelectrocatalysis. We are trying to clarify the interaction among composition make-up, morphology, and photoelectrocatalytic properties of material via an integrated study with a combinatorial rapid synthesis and screening method and a more controllable fabrication technique to optimize structure and morphology.

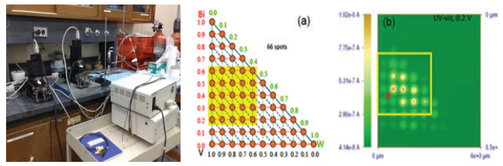
Son Hoang, The Surface Science laboratory, Department of Chemical Engineering - The University of Texas, 1 University Station, C0400 – Austin – TX 78712, Phone: 512-698-0591, Email : shoang@che.utexas.edu

SECURE THE FUTURE THROUGH RESEARCH AT THE FOREFRONT OF INNOVATION



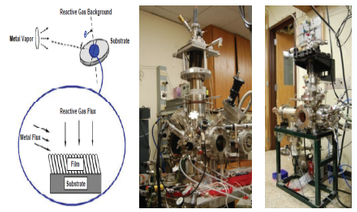
BIOFUELS RESEARCH LABORATORY

Scanning Photoelectrochemical Microscopy (SPCEM): Rapid synthesis and screening method to search for best candidates of water splitting photocatalysts from an astronomical number of possible multicomponent metal oxide semiconductors.



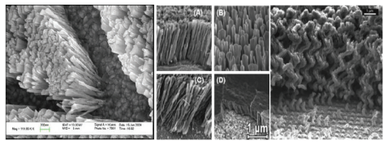
(a) Composition of array of combinatorially synthesized W-doped BiVO4 samples with
(b) SPECM analysis, which identified the 40%Bi/50%V/10%W “spot” as having 3 times the activity of the base metal oxide.

Reactive Ballistic Deposition (RBD) technique is an advanced in-vacuum technique to grow nano-structured thin films which demonstrate unique chemi-physical properties and optical, electronic, and magnetic properties different form dense films of similar chemical composition.



Mechanism of RBD technique and High vacuum chambers for RBD

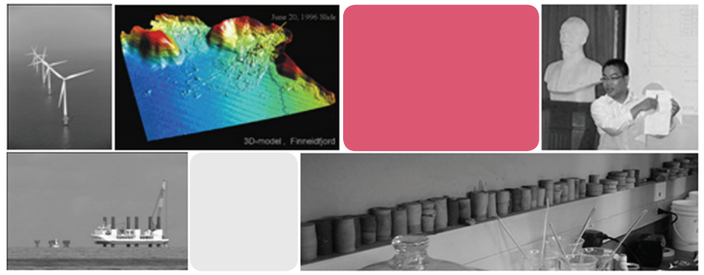
1. Scanning Electron Micrographs of α-Fe2O3 nano-coluums
2. TiO2 nano-coluums
3. Ti nano-helices grown via RBD technique



1. **2.** **3.**

OFFSHORE GEOHAZARDS AND GEOTECHNICAL ENGINEERING

SECURE THE FUTURE THROUGH RESEARCH AT THE FOREFRONT OF INNOVATION



RESEARCH COLLABORATIONS AND LINKS

Umass, Amherst
(www.ecs.umass.edu/geotech)

Norwegian
Geotechnical Institute
(www.ngi.no)

MIT Geomechanics
(www.cee.mit.edu)

Center for Offshore
Foundation Systems
(www.cofs.uwa.edu.au)

KEY EQUIPMENT

- Block Sampling
- Constant Rate of Strain
- Consolidation (CRSC)
- TruePath Automated
- Triaxial System
- Constant Volume Direct
- Simple Shear (DSS)
- Constant Volume
- Ring Shear (RS)

DID YOU KNOW?
All foundations are built on
and supported by soils

LAB VISION

Our lab seeks to form an international research and education collaboration among experts in offshore sediment geology, geotechnical engineering and disaster mitigation to:

1. Characterize fundamental physical aspects of seabed sediments including geomorphology, engineering properties, and in situ conditions that impact the sediments' susceptibility to geohazards, with a particular emphasis on events that would occur and/or impact coastal populations and infrastructure.
2. Develop geostatistics and geographic information tools that allow for assessment of sediments' spatial variability and orientation relative to critical coastal regions.
3. Propose engineering solutions to mitigate the potential damage from these geohazards to existing infrastructure and other affected resources,
4. Promote sustainable technical solutions for future infrastructure development in these zones.
5. Develop technical guidance and characterization/assessment protocols that will assist policymakers in shaping laws and regulations that govern coastal and offshore sites, and
6. Develop the educational resources and international interactions to train future geologists and engineers in fields related to these sediments and their role in geohazards and their effects.

IMMUNE FUNCTIONS:

The ultimate goal of our research plan is to develop protocols (e.g., design guidelines, standards, manuals of practice, public education documents) for the international community that can be used to accurately characterize offshore sediments and the role they play in assessment and mitigation of geohazards.

We are developing the tools and methodologies that are necessary for:

1. Accurate characterization of the engineering properties of seabed sediments, in situ pore pressures, and seabed geomorphology;
2. Characterization and database management/visualization of seabed property spatial variability which is a critical input for engineering stability calculations and risk assessment analysis; and
3. Delineating the linkage between geohazard triggering mechanisms and sediment properties/seabed geomorphology.

OUR FACILITIES

We develop and operate the most advanced soil mechanics laboratory testing equipment for characterizing soil engineering properties and complex soil behavior. We also operate a national geotechnical testing site located in our campus.

Figure 1: Block Sampling, the best soil sampling technique to get undisturbed soil samples for advanced laboratory testing testing

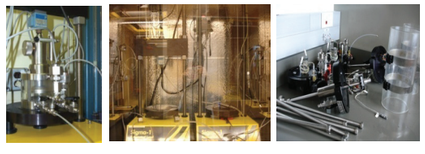


Figure 2: CRSC Cell, Automated TruePath Load Frame, and Triaxial Cell Equipment

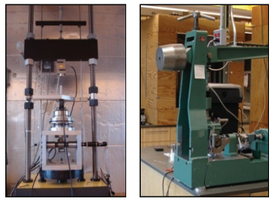


Figure 3: Constant volume ring shear and direct simple shear systems for characterizing undrained shear behavior of soils, e.g., in landslides

Hoang Q. Nguyen, 42C Marston Hall, University of Massachusetts Amherst, MA 01003 USA, Phone: (01) 617-412-1435,
Email: hoangn@engin.umass.edu or innovativeatwork@gmail.com

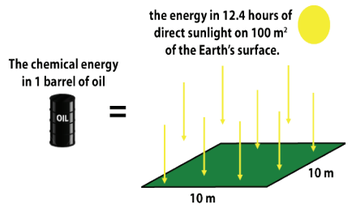
SOLAR
ENERGY INDUSTRY

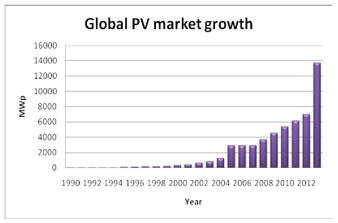
Da Vinci predicted a solar industrialization as far back as 1447

DID YOU KNOW?
World demand for PV
in 2012
will be about 17GW

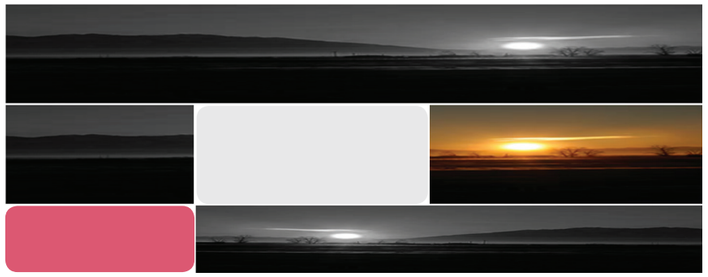
SOLAR ENERGY INDUSTRY

On average, the total energy of sunlight in one hectare per year costs about 400.000 USD. It is 100 times more than the total cost of the rice growing in the same area.





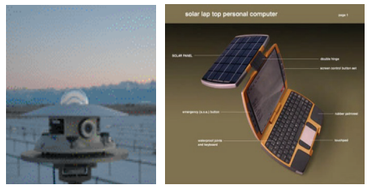
SECURE THE FUTURE THROUGH RESEARCH AT THE FOREFRONT OF INNOVATION



The cost of PV modules and associated system components depends on developing mass production techniques and facilities. A growing and stable market of PV system is developing. Figure shows the previous data and prediction data of the global market of PV from 1990 to 2013. The total Mega Watt Power of global solar PV market is doubled for the period from 2005 to 2008.

GT Solar is a leading equipment manufacturer in the production of polysilicon and multi-crystalline ingots. The company offers complete chain for manufacturing from sand to the solar module.

The output of one GT Solar furnace is 5 MW/year. For more detailed information: ***www.gtsolar.com***



Dung Nguyen Ph. D., 33 Sheridan Dr., Apt #6, Shrewsbury, MA 01545, USA, Phone: 617-412-8267, Email: nguyen.dun@neu.edu or dungnguyen03@gmail.com

NEXT GENERATION SEQUENCING

ARCHON X PRIZE FOR GENOMICS: $10 million to "the first Team that can build a device and use it to sequence 100 human genomes within 10 days or less, with an accuracy of no more than one error in every 100,000 bases sequenced, with sequences accurately covering at least 98% of the genome, and at a recurring cost of no more than $10,000 per genome".

REMARKS

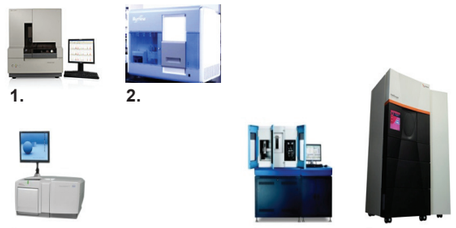
1977: DNA sequencing methods published
2003: first human genome in 13 years with a cost of $2.7 billion
2008: a human genome can be sequenced in 5 months for approximately $1.5 million

INTRODUCTION

DNA sequencing is a sequencing method to determine the order of nucleotides bases in a molecule of DNA.

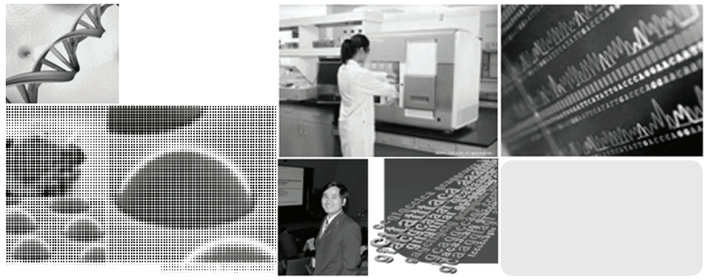
Next generation sequencing refers to DNA sequencing methods that make use of high-throughput sequencing technologies, which paralyze the sequencing process, producing thousands or millions of sequences at once

TECHNOLOGIES



1. Sanger
2. Illumina
3. TRoche 454
4. Solid
5. Helicos

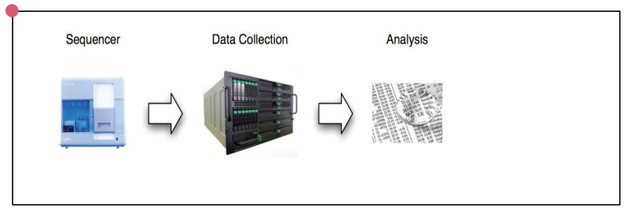
SECURE THE FUTURE THROUGH RESEARCH AT THE FOREFRONT OF INNOVATION



IIU GROUP - AREAS OF RESEARCH

- Small untranslated RNAs
- Gene expression and its regulation in hematopoietic stem cells and during cellular differentiation
- Application of small RNAs for modulating or enhancing immune responses
- MicroRNAexpression profiling to identify novel biomarkers

NGS PROTOCOL



EQUIPMENT AND REQUIREMENTS

- Sequencer (GA II) and Preparation Kits: $1,000,000
- Cost per run: $10,000 - $20,000
- Analysis equipments: high computing computers; high power cluster (memory ~ 72 GB, storage ~ 100 TB, multi-core nodes)

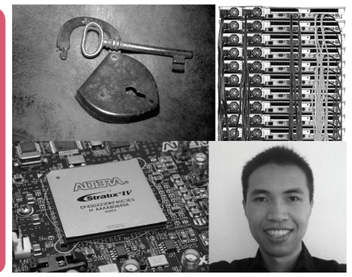
APPLICATIONS

- Complete genome resequencing
- Reduced representation sequencing
- Targeted genomic resequencing
- Paired end sequencing
- Metagenomic sequencing
- Transcriptome sequencing
- Small RNA sequencing
- Chromatin immunoprecipitation-sequencing (ChIP-Seq)
- Nuclease fragmentation and sequencing
- Molecular barcoding

Cuong Kieu Nguyen, Integrative Immunology Unit, Laboratory of Immunology, National Institute of Allergy and Infectious Diseases, National Institutes of Health, Phone:301-451-3227, Email:nguyenck@mail.nih.gov

ILLINOIS SYSTEM SECURITY LAB

SECURE THE FUTURE THROUGH RESEARCH AT THE FOREFRONT OF INNOVATION



TOWARD A SAFE DIGITAL FUTURE

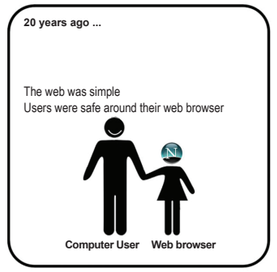
The internet, robot, cloud computing... technology has become an essential part of our lives.

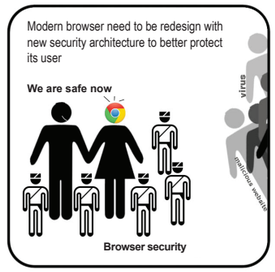
But, did you know that about 30000 new Internet threats, 55000 new computer viruses… are identified each day. And security is the #1 factor hindering wide adoption of cloud computing?

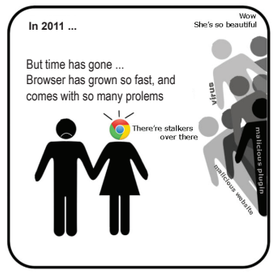
Our lab studies popular and emerging technologies, discover new security problems and propose new protection mechanisms.

Our goal is to make technologies safer to use, and as a result, improve the life and safety of the users.

BROWSER SECURITY







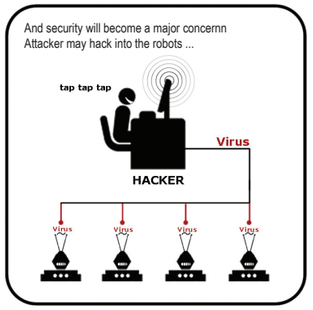
The web is totally is different from what it used to be 20 years ago. To support new web features, modern web browsers eventually grow into very complex programs, opening many new attack vectors. However, their security architecture has not been able to keep us with this pace.

We proposed a novel security architecture for web browsers, which isolates browsers components and web applications from each other, making it easier to detect and contain attacks. More info : goo.gl/f5R89

DID YOU KNOW ?

Our resaerch influenced the securtiy design of Google Chorme, Mozilla Firefox and Microsoft Internet Explorer

ROBOTIC SECURITY



Traiditional robot work inside factory, taking care of jobs that human are not good at. However, robots are becoming more and more popular and widely accepted, inside household environment. As an example, more than 6 million Roomba vacuuming robots were sold worldwide.

However, robots also pose many new security risks. Robotic system can be much more complex than personal computer; and with the ability to interact physically with human and their enviroment, robots could potentially cause more harm.

Our research explores this new frontier, aiming to learn the set of contraints and build a framework for more secure and safer robot. More info : goo.gl/VmknY.

Anh Minh Nguyen, Address: #4303, 201 N. Goodwin Ave, Urbana, IL 61801, Phone: 217 244-0216, Fax: 217 265-6582,
Email: anguyen7@illinois.edu

SECURE THE FUTURE THROUGH RESEARCH AT THE FOREFRONT OF INNOVATION

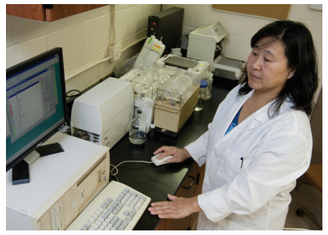
INTRODUCTION

The Soil and Water Quality Laboratory (SWQL) at the Tropical Research and Education Center of the University of Florida is a multidisciplinary research facility that has owned advanced equipment to support researches in soil and environmental quality.

A main mission of the SWQL is to assess nutrient pools in soil, sediment, plant tissue, and water quality in the South Florida, especially in the Everglades, where environmental quality has degraded due to human activities.

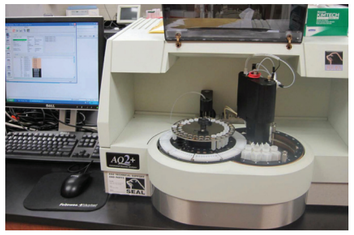
Chung T. Nguyen. Email: ntchung@ufl.edu or nguyentanchung@yahoo.com, Phone: (786) 547-8611

TECHNOLOGIES FOR SOIL AND ENVIRONMENTAL QUALITY ASSESSMENT



Bran Luebbe Auto-Analyzer 3

To measure P in water samples with very low concentration which can not be detected by ICP-MS or AQ2



Seal AQ2 discrete analyzer

To measure NH4+, NO3-, NO2- , and ortho-phosphate in soil, plant tissue, sediment, and water

ICP - MS

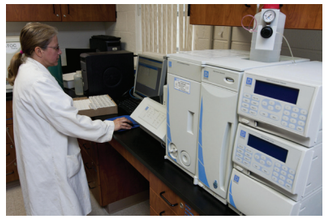
To measure metals and P in soil, plant tissue, water, and sediment , especially trace metals
Enable to concurrently measure to 40 different elements at the same time

Soil nutrients & water quality

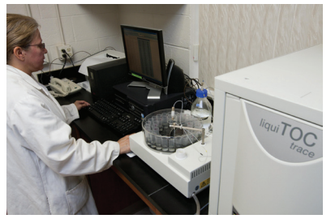
To measure F, Cl, SO42- in water samples, especially ortho-phosphate, NO3-, NO2- which can not be detected by AQ2

To measure total organic C and organic N in water samples

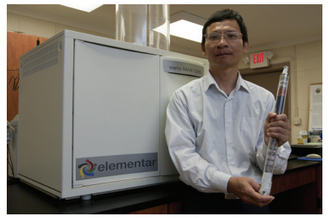
To measure total C, N, and S in soil, plant tissue, sediment, and ash



Dionex LC20 Chromatography



Liqui TOC Trace Elementar



Vario Max CNS analyzer

STRUCTURAL RESEARCH LABORATORY

- UNIVERSITY OF WASHINGTON

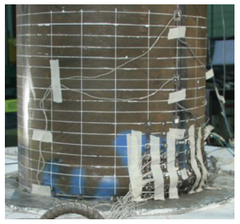
OUR GOAL IS BREAKING THINGS TO BETTER UNDERSTAND THEM

The collapse of the Tacoma Narrows Bridge (Washington State) in 1940 prompted a national discussion on bridge engineering. It was also a critical motivation for founding the University of Washington's Structural Laboratory in 1948 in the school's department of civil and environmental engineering.

LABORATORY RESEARCH AREAS:

University of Washington's Structural Research Laboratory is currently researching a wide range of issues dealing with crucial problems due to increased traffic and disasters (earthquakes, hurricanes…). The research includes:

- Gusset Plate Connections for Braced Frames.
- Rapid Construction Methods for Bridges.
- Concrete-Filled Tube (CFT) for Bridge Piers.
- Steel Shear Wall.



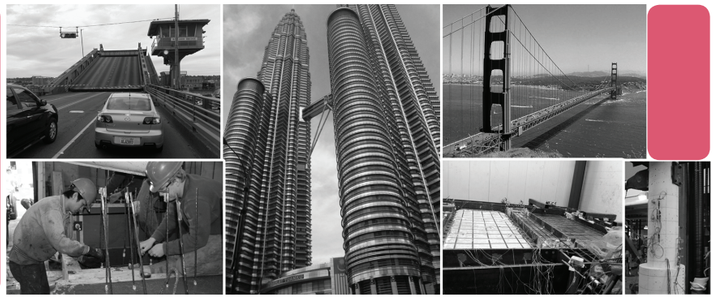
1.

2.

3.

1. CFT testing
2. Steel Shear Wall testing
3. Rapid Construction testing

SECURE THE FUTURE THROUGH RESEARCH AT THE FOREFRONT OF INNOVATION



LABORATORY EQUIPMENT AND TECHNOLOGY:

Baldwin testing machine:

The heart of the laboratory is "the Baldwin" machine. It is a 2.4 million servo-controlled compression device, which can test components as large as 25 feet tall. The Baldwin takes an important role since it can perform full-scale tests for earthquake stresses and extreme loads on bridges, ports, building, and other structures.

*"We've found in recent earthquakes that people made misleading decisions based on small-scale tests" – **Charles Roeder***

Earthquake Shaking Table:

This device is used for shaking structural models or components with a wide range of simulated ground motions. The table is driven in up to six degrees of freedom (DOFs) by servo-controlled actuators.

Portable Actuators:

One 500 kip capacity, one 220 kip capacity, and smaller portable actuators are applied for a variety of special applications. These actuators normally are worked in conjunction with strong floors and reaction walls which are provided in the Structural Research Laboratory.

*"Most labs can't take a structure completely to collapse because you have to be able to handle a large load and be able to control that load very precisely" – **Dawn Lehman**.*

Other equipment:

The Structural Research Laboratory is a fully equipped laboratory for research in structures. It contains diverse kinds of electronic and mechanical equipment such as load cells, potentiometers, inclinometers, linear variable differential transformers, and Optotrak systems, which are available for the measurement of load and response in structures. It also provides specialized computer systems and software (e.g. LabView …) used to gain and analyze data from tests.

Hung Viet Tran . Email: tvhung@uw.edu. or **Hang Thi Nguyet Nguyen** - Email: hangntn@uw.edu. Phone: (001) 919-757-5797

SMART LABEL

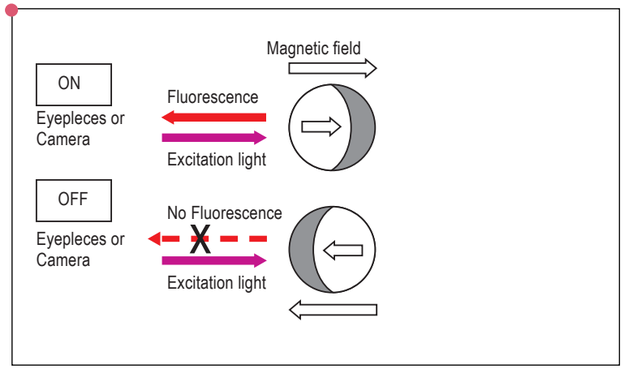
The Anker's laboratory at Clemson University is interested in studying chemical and biophysical processes using modulated/fabricated micro- and nanoparticles. Molecular detection and cellular imaging use fluorescence as one of the most sensitive methods. However, the choices of fluorescent dye types and the suitable experimental conditions are limited due to background fluorescence of the samples/tissues and instrumental optics. The high background intensity compared to the detecting probe's signal makes the detection difficult. Based on the fact that blinking signal is easily detected and distinguished from the little or slow change background, we use a technique that can overcome this difficulty called Smart label. The probes fabricated using this method can be wisely combined with proper components to make nanoinstruments (***such as nanoviscometers, nanobarometers, nanothermometers, and nanochemical sensors for immunoassays)*** for local properties study with high sensitivity.

We don't have fancy facilities.
The way we make
our equipment unique
is building them up
based on what we need
without spending too much.

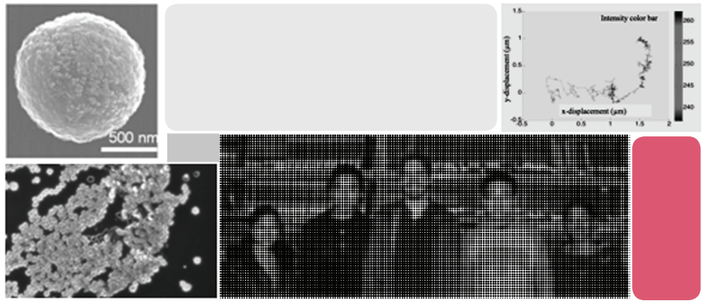
HOW DOES IT WORK?

We modulate the optical property of spherical fluorescent particles by metal (Ni or Co) vapor deposition. The metal coated and uncoated sides have different intensity. Those fabricated particles are bright and can be modulated by an external magnetic field so they can be detected and separated from the background.

Other types of particles can also be fabricated based on this method. If the particles are not fluorescent, we can still observe their scattering in dark field; if the particles are themselves magnetic, we can coat them with non-magnetic metal such as Al, Ag or Au.

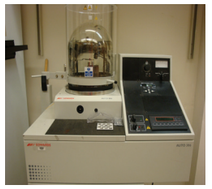


SECURE THE FUTURE THROUGH RESEARCH AT THE FOREFRONT OF INNOVATION

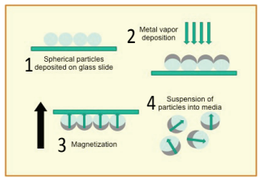


PARTICLE FABRICATION

The particle fabrication is described as in the diagram below using the vapor deposition.



1.



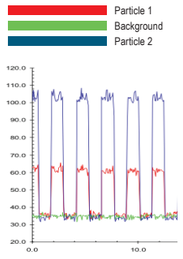
2.

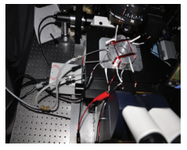
1. Vapor deposition

2. Schematic diagram of the particles fabrication

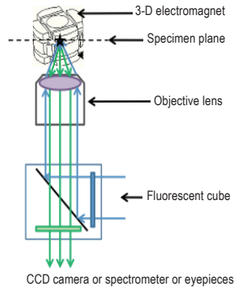
OBSERVATION

We use the Leica DMI 5000M microscope to collect the signal and a three dimensional electromagnet to control the orientation of particles. The three dimensional electromagnet is expected to be able to orient the particles at any angle. This system can be used to study the translation and rotation as well as viscosity of an intracellular environment.





Fluorescence of 2 fabricated particles with an external field modulation are clearly separated from the background.



KhanhVan Nguyen, Address: 102 Biosystems Research Complex, Clemson University , Clemson, SC 29634 – Phone: (001) 864 643 8088 – Email: khanhvn@clemson.edu

NANOTECHNOLOGY - MICRO DEVICE - BIO MATERIALS

TRANSFORMATIVE BIOMEDICAL & ENERGY DEVICES

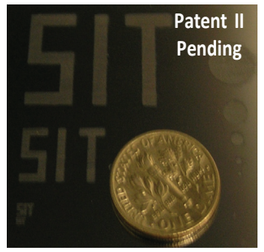
MICROFLUIDIC TOOLS

NANOSCALE PHENOMENA

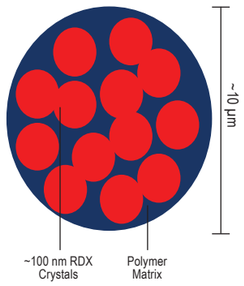
NANOENERGETICS FOR SAFE MUNITIONS

Manufacturing Demo

Inkjet Printing



Microscale Droplet **(RDX & Polymer Dissolved in Acetone)**

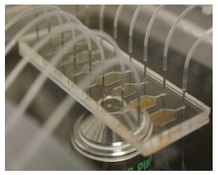


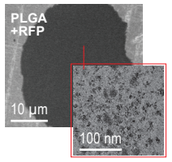
	Shock Sensitivity (kbar)
Conventional	24.5
Nano-RDX	40.4

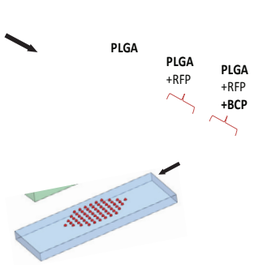
Discovery
One-step synthesis of RDX nanocomposite powder & patterns

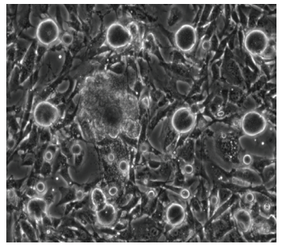
SECURE THE FUTURE THROUGH RESEARCH AT THE FOREFRONT OF INNOVATION

INKJET-PRINTED, ANTIBIOTIC- & CALCIUM-ELUTING MICROPATTERNS

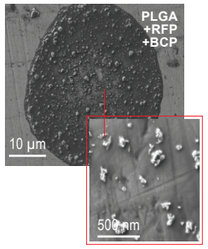




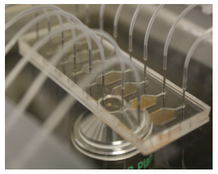


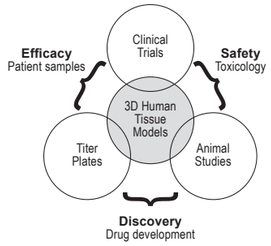


Without Antibiotic Elution

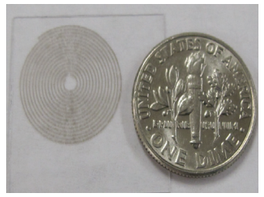


3D MICROFLUIDIC BONE TISSUE

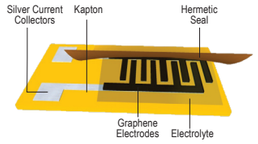




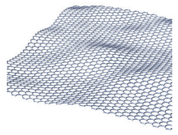
Physiological Microenvironments
Real-time imaging
High-throughput
Long-term culture



Novel Properties
- Electrically conductive
- Optically transparent
- Mechanically strong & conformal
- High surface area
- Chemically & electrochemically inert



Graphene: A New 2D Nanoscale Building Block



Scalable NanoManufacturing
- 3D graphene assembly
- Flexible supercapacitor electrode, solar cell window, antenna
- Large-scale production from biomass waste

Linh T. Le, Address: Castle Point on Hudson, Stevens Institute of Technology, Hoboken, NJ, 07030 Email: linhle@veffa.org Phone: +1-201-216-5332

GENERAL ROBOTICS, AUTOMATION, SENSING AND PERCEPTION (GRASP) LABORATORY - UPENN

Robotics & Automation are interdisciplinary, challenging, exciting areas, and among the fastest-growing industries

INTERESTING FACTS
Penn Engineering is the home of ENIAC – the first general-purpose electronic computer
The word "robot" was coined in 1920 by Czech writer Karel Čapek

Founded in 1979, the General Robotics, Automation, Sensing and Perception (GRASP) Laboratory at the University of Pennsylvania is a leading research center in robotics in the United States. With more than 15 professors, 10 post-docs and over 100 doctoral and master students in computer science, electrical engineering and mechanical engineering, the lab integrates interdisciplinary areas and boasts a vibrant, collaborative environment that fosters interactions between its members.
GRASP has grown into a $10 million research center with impressive technological innovations. It is a major center for many research projects sponsored by government agencies such as NSF, DARPA, ONR, as well as many industrial companies.
Our doctoral students are trained in theory and practice and mentored to become leaders in research and education. Our Master's in Robotics program equips students with knowledge and skills to face research and development challenges of the robotics industry.

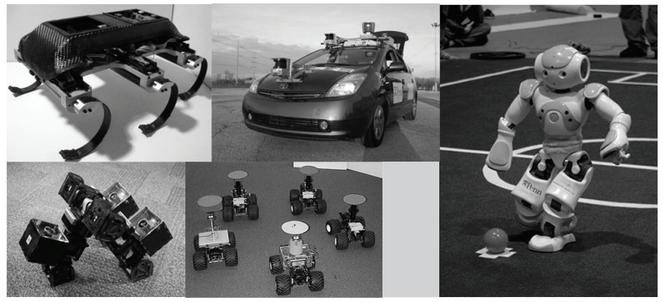
MACHINE LEARNING & SMART TECHNOLOGIES

Using machine learning and other smart technologies to develop smart cameras, image matching, image recognition, 3D model construction, human activity detection and recognition, and many more.

BIOLOGICALLY INSPIRED ROBOTS

Learning from biology, we build robotsthat can run, crawl, survive, fly, climb,just like animals and insects.
Or evenplay soccer like human (RoboCup).

SECURE THE FUTURE THROUGH RESEARCH AT THE FOREFRONT OF INNOVATION

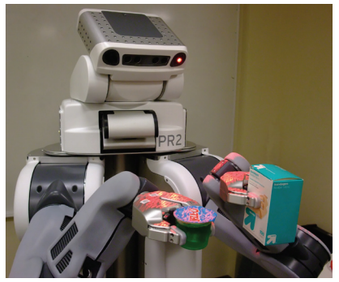


MODULER ROBOTS

A robot system consisting ofmultiple simple module blocksthat can change shape, adapt toenvironment, self-assembly and self-repair.

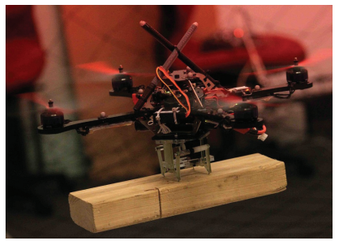
HUMAN-MACHINE INTERFACE

Improve the interaction between human and machines via advanced technologies such as haptography, tactile feedback and grasping, tele-immersion.



AUTONOMOUS VEHICLES & ROBOTS ROBOT SWARMS

We develop technologies and build vehicles and robots, of micro to large size, that can perform complex tasks on their owns, or collaborate with others in a network/swarm to achieve very complex goals.
Unmanned aerial vehicles (UAV), quadrotors.
Autonomous cars: DARPA Urban Challenge.
Micro autonomous robot systems.
Heterogeneous unmanned networked teams.



Truong X. Nghiem, nghiem@seas.upenn.edu or truong.nghiem@gmail.com – (1)-267-207-0426, http://www.grasp.upenn.edu

SCHOOL OF PACKAGING LABORATORY SYSTEM,

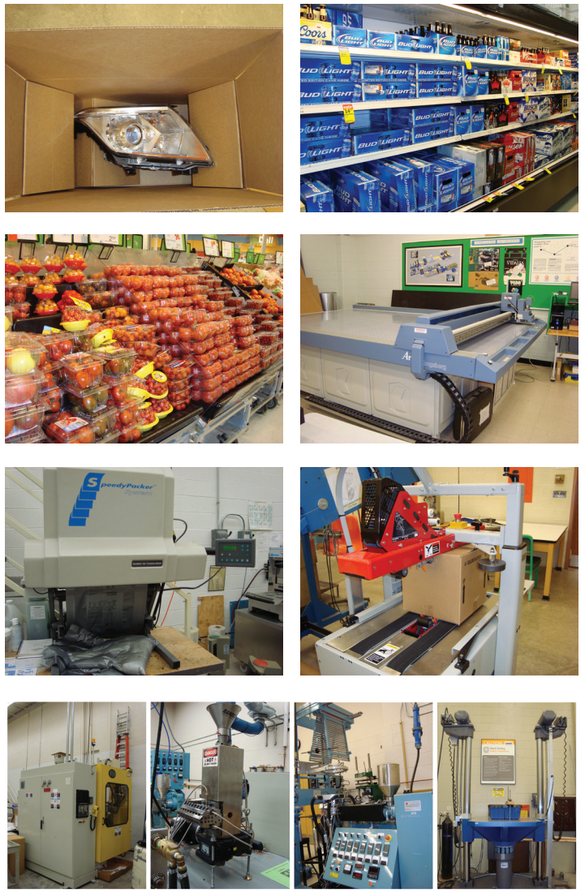
MICHIGAN STATE UNIVERSITY

For more than 50 years, the School of Packaging at Michigan State University has been a global leader in packaging education, research, and outreach (1).

Packaging ensures that the products are protected, enclosed, and well communicated to consumers during transportation, warehousing, sales, and end use (2). Packaging is both a science and a technology field with a high level of expertise.

As the third largest industry after Food and Energy/Petrochemicals, the global packaging industry turned over around $564 billion in 2009 (3).

Product fragility assessment, package design, and sample making



ADVANCING KNOWLEDGE & TRANSFORMING LIVES

Shock, vibration, compression testing, and modeling of distribution environment (ISTA 1A, 1B, 1C, 1D, 1G, 1H, 2A, 2B, 2C, 2D, 2E, 2F, 3A, 3E, and 3F; ASTM D642, D999, D1185, D1596, D3580, D4169, D4577, D4728, D5276, D5487, and D6653; ISO 8611-1 and USPS-P-4002) (4).

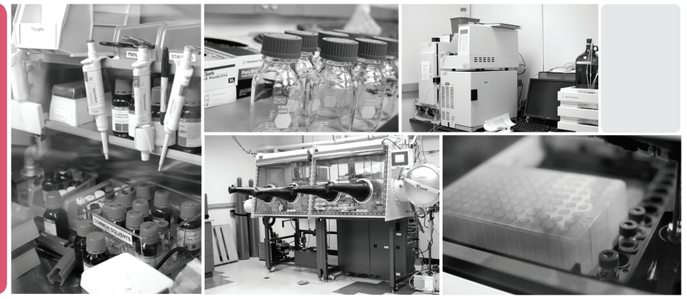
Package integrity, seal strength, and corrugated fiberboard and paperboard tests (TAPPI 410, 411, 414, 804, 810, 815, 821 and 822) (5).

Permeability, migration, accelerated shelf-life, and stability studies (6).

Tuan A. Nguyen, 103 Packaging Bld., East Lansing, MI 48824, 616-516-9977, nguye169@msu.edu

HIGH-THROUGHPUT EXPERIMENTATION LABORATORY FOR ORGANIC SYNTHESIS

SECURE THE FUTURE THROUGH RESEARCH AT THE FOREFRONT OF INNOVATION



HTE laboratory allows hundreds of reactions per day, by means of 24- or 96-well reaction plates, through the use of the smallest amounts of chemicals necessary and automated screening of the reaction products

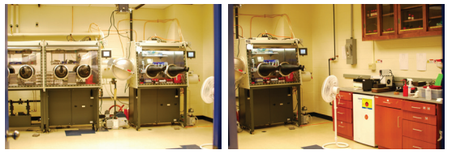
The High Throughput Experimentation (HTE) Laboratory is a joint research facility emerging from a collaboration between Merck and the Department of Chemistry at the University of Pennsylvania and is among the first three HTE centers in US outside the industrially agrochemical and pharmaceutical environment.

ONGOING PROJECTS

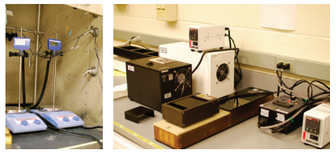
- Oxidative coupling reactions of phenols and napthtols
- Organometallic reactions with organotrifluoroborates
- Development of nitro compounds

BASIC COMPONENTS OF HTE LABORATORY

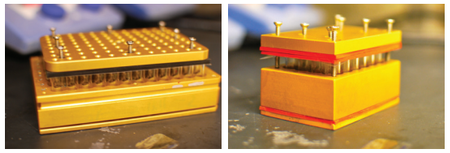
Glove boxes, providing an oxygen-free environment



Heating and stirring systems including temperature control and tumble stirrers



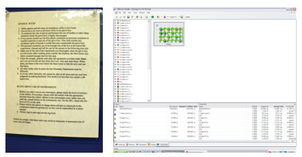
24- or 96-well reaction plates and vials with plastic seal



Collections of chemical compounds

24- or 96-well reaction plates and vials with plastic seal

Collections of chemical compounds



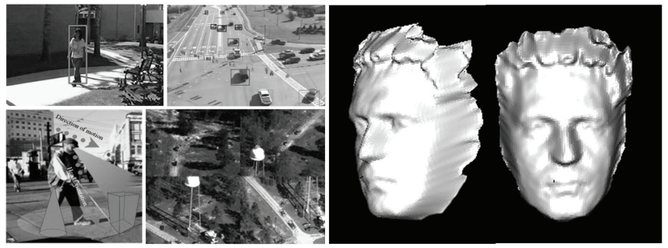
Analysis systems including HPLC, SFC and LCMS

Trung Cao. Department of Chemistry, University of Pennsylvania. Email: trungcao@sas.upenn.edu. Tel: (001) 215-573-4249

COMPUTER VISION LAB @ UNIVERSITY OF SOUTHERN CALIFORNIA

http://iris.usc.edu/USC-Computer-Vision.html

WHERE THE COMPUTERS CAN SEE AND LEARN



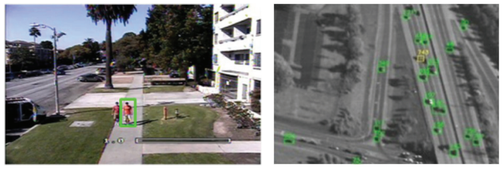
The Computer Vision Lab at the University of Southern California is one of the major centers of computer vision research for thirty years. We conduct research in a number of basic and applied areas. Research topics include visual tracking, object recognition, action recognition, 3D modeling, motion analysis. We have worked on applications to robotics, manufacturing, mobile robots, surveillance and aerial photo analysis.

We are a part of Institute for Robotics and Intelligent Systems (IRIS), USC Viterbi School of Engineering,University of Southern California.

FIGHT ON!

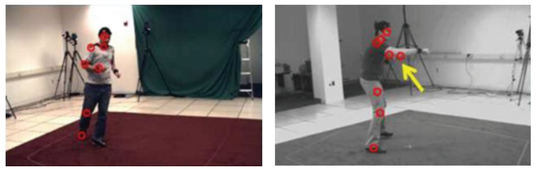
VISUAL TRACKING

There are two main sub-topics: single object tracking and multiple object tracking. In single object tracking, we can follow any type of objects which are initially tagged. We deploy our algorithms on a real-world application where an active camera follows an object of interest automatically. In multiple object tracking, the focus is on data association between the detection responses to form the right trajectory for each object. The data can be pedestrians or cars captured from Unmanned Arial Vehicles.



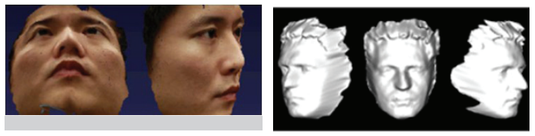
ACTION RECOGNITION

We focus on recognizing actions of people in a video sequence. For example, how can the computer learn to tell a person is walking or running? And not always the camera is put in the right angle to give us the best results. To address this problem, we build view-invariant 3D models of human motion. With this model, it is not only robust in recognizing within an arbitrary viewpoint, but also efficient in handling the occlusion.



3D FACE MODELING

The goal is to model the face in 3D with very limited input data. With 3D face models, we can integrate them into face recognition systems to recognize people robustly. Also, we already deployed a facial expression recognition algorithm to allow the computer to detect the feelings of a person such as: smile, sad, angry… based on his/her expressions. We are also developing a 3D face modeling method using a single webcam with low resolution which promises a very high impact in research and practice.

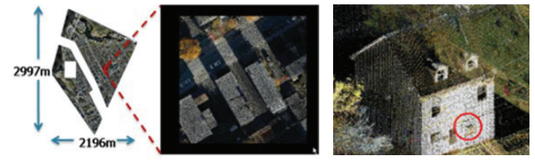


ROBOT VISION VISUALLY IMPAIRED

With the fact that there are 161 million people having vision loss world-wide, we are trying to develop a vision-based mobility aid to help visually impaired persons navigate.
Our system detects the obstacles using a head-mounted kit and signals to the user through the vibrating motors attached in the mobile vest. All of the data and commands are transferred through a wireless network.

OBJECT CATEGORIZATION FROM RANGE IMAGES

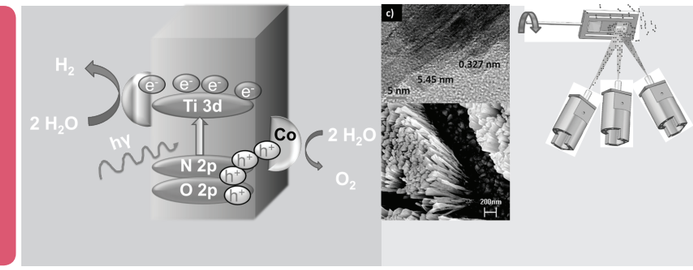
The focus of this project is to categorize the objects in depth videos. The data collection is done using real-time range sensors or LIDAR sensors which gives a huge number of 3D points in large area.
We segment the object from the scene and then identify its category. It also can learn a new category. The data is formulated as visual vocabularies and an online machine learning algorithm is applied to learn and infer the class of objects.



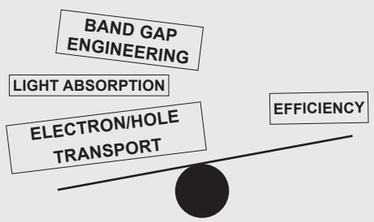
Thang Dinh, Address: 3737 Watt Way, PHE 226, Los Angeles, CA 90089-0273 Email: thangdb@gmail.com, Phone: (+1) 213-740-6441, Website: http://iris.usc.edu/people/thangdin/index.html

PHOTOELECTROCATALYSTS
FOR SOLAR HYDROGEN PRODUCTION FROM WATER SPLITTING

SECURE THE FUTURE THROUGH RESEARCH AT THE FOREFRONT OF INNOVATION



HOW TO MAXIMIZE SOLAR-TO -HYDROGEN EFFICIENCY?



DID YOU KNOW?
The Sun radiates our planet with 105 TW

Global power consumption in 2001 was ~ 13.5 TW

Photocatalysts with long term stability and at least 10% efficiency is required for practical application

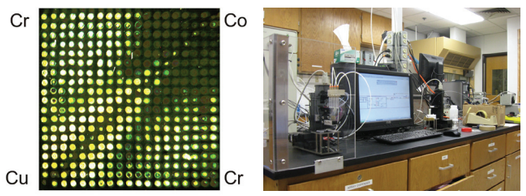
INTRODUCTION

Semi-conductors under appropriate solar irradiation generate electrons and holes which can split water into gaseous hydrogen and oxygen. The production of hydrogen from solar water splitting reaction has been termed a “Holy Grail” of chemistry.

As a research subgroup of the surface chemistry lab, the Photoelectrocatalyst team seeks to contribute knowledge regarding solar-irradiation driven water splitting photoelectrocatalysis. We are trying to clarify the interaction among composition make-up, morphology, and photoelectrocatalytic properties of material via an integrated study with a combinatorial rapid synthesis and screening method and a more controllable fabrication technique to optimize structure and morphology.

FACILITIES AND METHODOLOGY

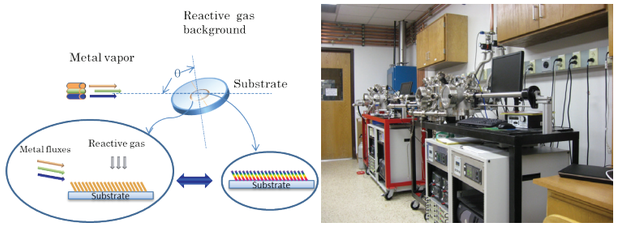
PHOTOELECTROCHEMICAL SCANNING Rapid synthesis and screening method to search for best candidates of water splitting photocatalysts from an astronomical number of possible multicomponent metal oxide semiconductors.



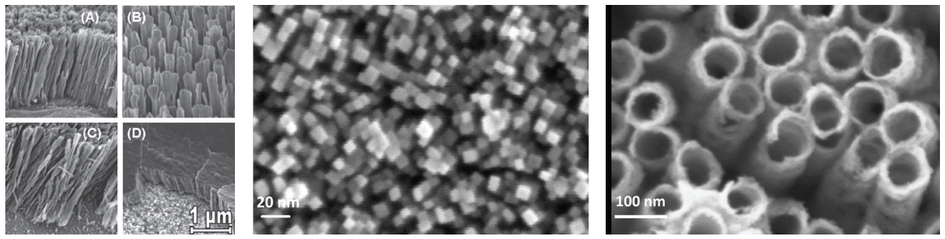
Mixed-metal oxide arrays of Co, Cu, and Cr. There are total 400 spots with different compositions on 0.9 cm x 0.9 cm substrates
The Dispenser (for rapid synthesis of the arrays with 4 components) and Scanning system (for rapid screening photoactivity of the arrays).

REACTIVE BALLISTIC DEPOSITION (RBD) technique is an advanced in-vacuum technique to grow nano-structured thin films which demonstrate unique chemi-physical properties and optical, electronic, and magnetic properties different form dense films of similar chemical composition. We are one of very few groups who are able to synthesize nano-structured films of up to 4 metal components with controllable compositions. We have 5 high vacuum chambers and 20 home-built electron-beam evaporators dedicated to RBD synthesis.

Mechanism of RBD technique and
High vacuum chambers for RBD



We also utilize various techniques such as SPRAY PYROLYSIS, Electrochemical Anodization, and HYDROTHERMAL SYNTHESIS to synthesize nano-structured morphology.



(Left to right) Scanning Electron Micrographs of RBD TiO2 nano-coluums, TiO2 nano-wire arrays grown via hydrothermal synthesis , and Ti nanotube arrays grown via Electrochemical Anodization.

Son Hoang – The Surface Science laboratory – Department of Chemical Engineering - The University of Texas – 1 University Station, C0400 – Austin – TX 78712
Phone: 512-698-0591 – shoang@che.utexas.edu

UC SAN DIEGO, THE LAWRENCE LIVERMORE AND THE PACIFIC NORTHWEST NATIONAL LABORATORIES

UCSD

Pacific Northwest NATIONAL LABORATORY

Proudly Operated by Battelle *Since 1965*

- **THE BAMBOO PROJECT- A COLLABORATION FOR VERY LARGE-SCALE SIMULATIONS**

1. WHAT WE ARE DOING

We are building a translator to automatically optimize very large-scale simulations running on supercomputers.

- LLNL provides the compiler framework (ROSE).
- The Scientific Computing group of UCSD designs and implement the translator.
- PNNL provides input simulations (Nwchem).

ROSE

NWChem high performance computational chemistry software

2. EQUIPMENTS.

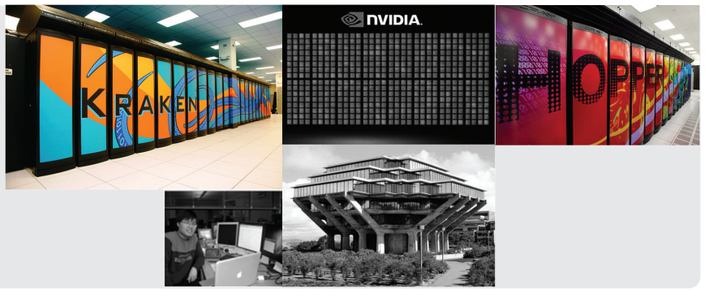
We use state-of-the-art supercomputers provided by Teragrid. On the top 500 fastest supercomputers:

- Hopper: ranked 8th
- Kraken: ranked 11th
- Franklin: ranked 27th

http://www.top500.org/
As of Sept-04-2011

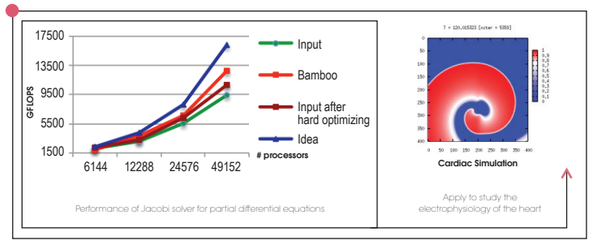
...

SECURE THE FUTURE THROUGH RESEARCH AT THE FOREFRONT OF INNOVATION



3. WHAT WE HAVE BEEN UP TO RECENTLY

- We finished the first software version (Bamboo 1.0).
- We challenged Bamboo with five applications.
- We are translating modules in Nwchem.
- We hope to publish Bamboo at the end of this year.



4. A STORY NEVER TOLD BEFORE!

That is, the main software for Bamboo was originally called Hue (Húê), a beautiful city in Vietnam. Since it's a bit hard to pronouce Hue, we renamed this software to Pensee, a lovely flower.

5. MORE DETAILS? CHECK OUT OUR WEBSITE

http://nnguyenthanh.ucsd.edu/bamboo/bamboo.html

6. ACKNOWLEDGMENT

- Tan Nguyen is a fellow of the Vietnam Education Foundation, cohort 2009.
- The project is funded by the Department of Energy, US.
- The computations are run on Teragrid's supercomputers. We thank Nersc (Berkeley), NCSA (Illinois), SDSC (San Diego), NICS (Tennessee) and many other computing centers.

Tan Nguyen. Email: nnguyenthanh@eng.ucsd.edu Website: http://nnguyenthanh.ucsd.edu

CHAPTER 3

LIFE SCIENCE LABS

NANOSCALE INTEGRATED TECHNOLOGIES AND SYSTEMS

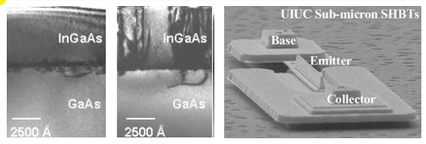
Is it only the Science. Since the first transistor was invented by John Bardeen in 1947 and the first integrated circuit was invented by Jack Kilby in 1958, semiconductor continues to grow as the backbone industry in the global IT economy.

DID YOU KNOW?
The worldwide semiconductor industry collected $261.9 billion in revenue in 2008

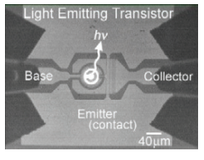
- The Micro and Nanotechnology Laboratory (MNTL) of the University of Illinois at Urbana-Champaign is a multidisciplinary research facility that houses advanced equipment to support cutting-edge researches in photonics, microelectronics, nanotechnology, and biotechnology.
- As a research unit of the MNTL, the High Speed Integrated Circuits (HSIC) mission is to explore the solutions to create innovative semiconductor devices and monolithic microwave integrated circuits (MMICs) for communication systems working across the spectrum of 1 GHz to 1 THz.
- The research programs in HSIC continue to expand thanks to major awards from our government sponsor, DARPA, along with our industry and research partners.

SEMICONDUCTOR DEVICES

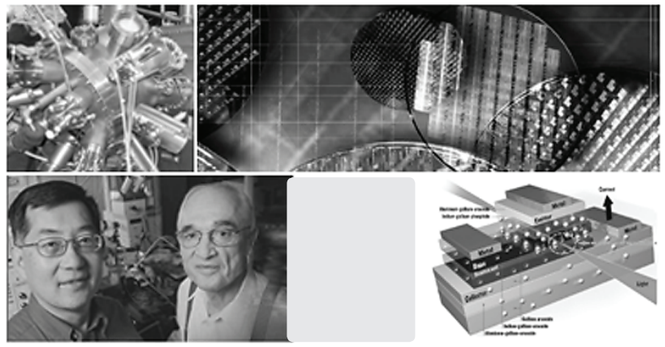
Our primary focus is Heterojunction Bipolar Transistors (HBTs) using InP/GaAsSb material to enter terahertz operation.



Optoelectronic device researches include InGaP/GaAs light-emitting transistors and transistor lasers which open a new gate for the era of limitless computing power and bandwidth.



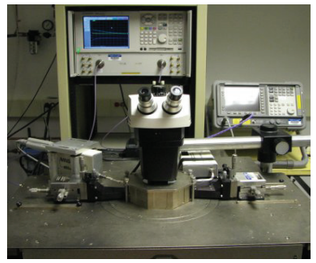
SECURE THE FUTURE THROUGH RESEARCH AT THE FOREFRONT OF INNOVATION

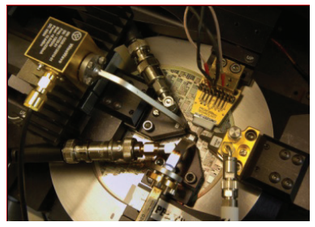


DEVICE CHARACTERIZATION AND MODELING

. Accurate on-wafer characterization and modeling of semiconductor devices are crucial to guarantee first-pass integrated circuit (IC) design, and hence reduce the product development cycle.

. HSIC researches focus on developing large-signal as well as noise model for many different semiconductor devices such as HBTs, MESFETs and MOSFETs.

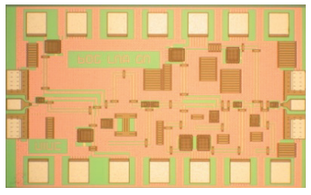




SEMICONDUCTOR DEVICES

. Robust integrated circuit is a joint effort of novel device fabrication, accurate modeling development, and advanced circuit technique.

. HSIC researches focus on the development of novel RF/ mixed signal integrated circuits and communication systems



Giang D. Nguyen, Email: gnguyen3@uiuc.edu or ndgiangbk@yahoo.com, Phone: (001) 309-868-4287

CANCER BIOLOGY AND MOLECULAR SIGNALING RESEARCH AND CANCER THERAPY INNOVATION

SECURE THE FUTURE THROUGH RESEARCH AT THE FOREFRONT OF INNOVATION

Many current anti-cancer therapies are toxic and can also kill normal cells. Therefore, it is very important and urgent to develop novel targeted anticancer therapies that can effectively eliminate cancer cells with minimal toxicity for normal cells. An essential requirement for these therapies is a complete understanding about molecular signaling pathways and biology of cancer cells.

MANY CANCER RESEARCH PROJECTS ARE IN PROGRESS…
Cancer Genome Atlas
Cancer Metabolome Atlas
Cancer Therapy Innovation
Cancer Cell Signaling Study
Center for Biological Pathways
Breast Cancer Basic Research Program
Among others…

THE UNIVERSITY OF TEXAS AT HOUSTON M. D. ANDERSON CANCER CENTER

DEPARTMENT OF MOLECULAR AND CELLULAR ONCOLOGY

M. D. Anderson Cancer Center is the #1 Cancer Center in The United States of America. Our mission is to is to eliminate cancer in Texas, the nation, and the world through outstanding programs that integrate patient care, research, and prevention, and through education for undergraduate and graduate students, trainees, professionals, employees and the public.

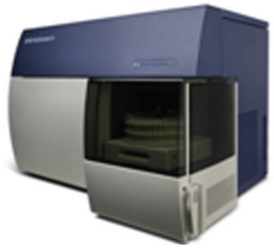
The Department of Molecular and Cellular Oncology is committed to establishing a strong research group focused on the molecular and cellular aspects of cancer research, which will be the foundation for future cancer therapies.

A number of faculty members in the department are interested in breast cancer research, and most have received peer-reviewed breast cancer-related extramural research funding. Research interests include growth factor receptors, oncoproteins, tumor suppressors, cytokines and cell survival and apoptosis factors. Specific molecules currently under investigation include the epidermal growth factor receptor family, estrogen receptor, tumor necrosis factor-alpha, IL-2, Akt, Pak1, nuclear factor-kappa B, p16, p27Kip1, p57Kip2, p21Cip1, Rb, p53, BRCA2 and p202.

My current research project focuses on breast cancer metabolism regulation. We aim to specifically inhibit cancer energy production pathways, thereby selectively starving and eliminating tumor cells. Our strategies include gene therapy and chemotherapy innovation. Our research has been done on variety of breast cancer cell lines and mouse models and has a very promising potential. The results from our study contribute to establish the scientific foundation to develop effective personalized and cancer-targeted therapies.

In addition to standard molecular biology equipment, we also use many advanced tools for our research such as Nuclear Magnetic Resonance Spectrometer, Confocal Live Cell Imaging Microscope, Cancer Genome Atlas, etc.

Olympus Confocal Microscope for Cell Imaging



LiemPhan, The University of Texas at Houston, M.D. Anderson Cancer Center, Department of Molecular and Cellular Oncology, 1515 Holcombe Blvd, Houston, Texas, USA. Email: Liem.M.Phan@uth.tmc.edu

INNOVATIVE TECHNOLOGY IN ENVIRONMENTAL TECHNOLOGY: HIGH QUALITY WATER FOR EVERYONE

- 1 Billion people are without access to safe drinking water
- Access to safe water is a Human right, not a privilege.
- Innovative technology in Drinking water treatment Provide high quality water Reduce energy cost

KEY EQUIPMENT

- High performance size Exclusion chromatography **(HPSEC)**
- Total organic carbon and Total nitrogen analyzer **(TOC-TN)**
- Ion chromatography **(IC)**
- X-ray Photoelectron Spectroscopy **(XPS)**
- Field Emission Scanning Electron Microscopy **(FESEM)**
- ATR FTIR Online data acquisition

THE ENVIRONMENTAL GROUP AT THE UNIVERSITY OF MASSACHUSETTS AMHERST FOCUSES ON ENVIRONMENTAL AND ENVIRONMENTAL HEALTH ISSUES:

- Drinking water
- Environmental Microbiology and Wastewater treatment
- Water Resources and Hydrology
- Water, Climate and Sustainability
- Stormwater and Watershed Management
- Groundwater and Hazadous Waste

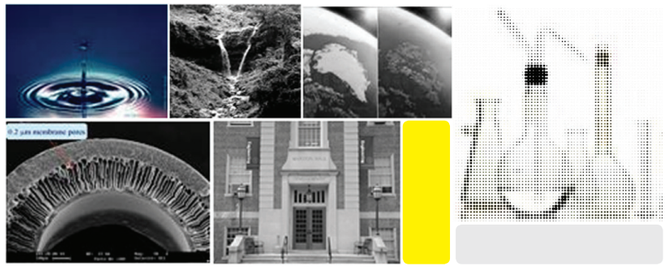
THE DRINKING WATER GROUP FOCUSES ON INNOVATIVE TECHNOLOGY:

- Use of innovative technology in water treatment
- Study of disinfectant by-products that adversely impact human health
- Analytical methods to identify toxins in drinking water including EDCs, N-DBPs

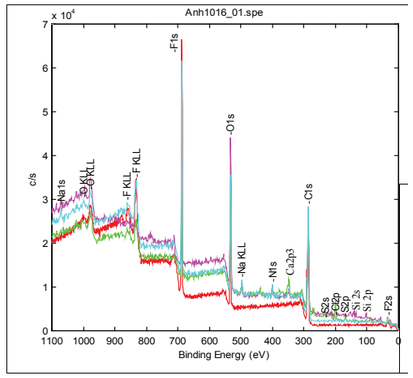
MEMBRANE TECHNOLOGY AS AN INNOVATIVE TECHNOLOGY FOR DRINKING WATER TREATMENT AND WASTE WATER REUSE:

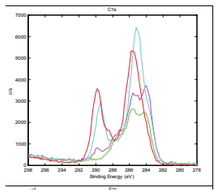
- Increase use of membrane due to increasing demand for high quality potable water
- Capacity to use of poorer quality water sources
- Increase waste water reuse
- Desalination: producing portable water from sea and saline water

SECURE THE FUTURE THROUGH RESEARCH AT THE FOREFRONT OF INNOVATION

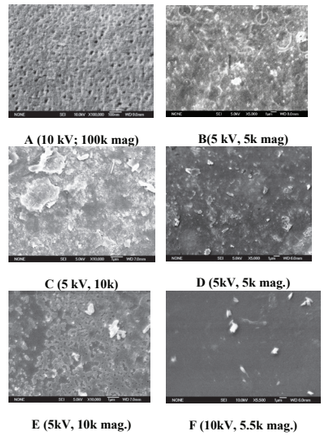


ELEMENTARY COMPOSITION OF MEMBRANE SURFACE DETERMINED BY XPS





NANO-SCALE PICTURE IMAGING WITH FESEM



Anh Nguyen - 18 Marston Hall, University of Massachusetts Amherst, 130 Natural Resources Road, Amherst, MA 01003.
USA Phone: 413-577-3236. Email: hanguyen@ecs.umass.edu

LEGUME -MICROBE INTERACTIONS LABORATORY

The interests of the laboratory are diverse but have a common theme of plant and microbe development. A variety of structural and functional genomic methods are being used to understand the way in which legumes respond to microbial infection

DID YOU KNOW?
The variety of data we got came from our collaborative efforts.
We can make it. Why can't YOU?

WELCOME TO THE LEGUME-MICROBE INTERACTIONS LABORATORY AT THE UNIVERSITY OF MISSOURI. THE LABORATORY IS DIRECTED BY PROFESSOR GARY STACEY, MSMC ENDOWED PROFESSOR OF SOYBEAN BIOTECHNOLOGY.

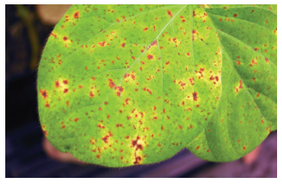
RESEARCH PROJECTS

IN OUR LAB, WE FOCUS ON TWO PLANT MODELS: ARABIDOPSIS (A PLANT MODEL FOR BASIC RESEARCH) AND SOYBEAN (ONE OF THE IMPORTANT CROP PLANTS IN THE US)

ARABIDOPSIS

Role of extracellular ATP in plants. The laboratory is focused on elucidating how plants recognize eATP, a ubiquitous compound, and how this recognition leads to changes in plant physiology. We believe that eATP is a fundamental, essential signal in plants.

Chitin/lipo-chitin recognition by plants. Plants are able to recognize chitin, a component of pathogenic fungi cell wall, and trigger basal defense responses against pathogen. Our goal is to elucidate how plants recognize these structures using structurally similar receptors but then respond in distinctly different ways.

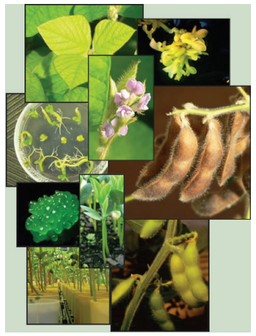


PLANT RESEARCH – STAY GREEN FOR A GREAT FUTURE ON EARTH

SOYBEAN

Soybean Mutagenesis. By transposon tagging and fast neutron mutagenesis, our long-term goal is to make variety of soybean mutant lines available for the soybean community through a seed bank facility.

Root Hair Systems Biology. This project uses functional genomics to investigate the impact of biotic and abiotic stress on legume root hairs, a single cell model for systems biology.



FACILITIES AND RESOURCES

Life Sciences Center. Our lab is located in the Life Sciences Center and is able to access Core Facilities including Electron Microscopy Core, DNA Sequencing Core, Proteomics Core, Molecular Cytology Core, Transgenic Animal Core, and so on.

A group of diverse nationalities provides the potential resource for world-wide cooperation in present and future.

MORE TO KNOW FROM VIETNAM

- Our website: http://www.staceylab.missouri.edu,
- Our Life Sciences Center: http://bondlsc.missouri.edu
- Our National Center for Soybean Biotechnology:
- http://www.soybiotechcenter.org/

Finally, did you know that we can access the collection of state-of-the-art facilities from Environmental Molecular Sciences Laboratory (Department of Energy)?
Start writing a grant to be their users from Vietnam now: http://www.emsl.pnl.gov/emslweb/

Tran Nguyen. Address: Room 201, Life Sciences Center 1201 Rollins Road, Columbia, MO, 65201. Phone: (+1) 573-884-4799, Email: thny8c@mail.missouri.edu

THE SOYBEAN GENETICS AND DEVELOPMENT LABORATORY AT THE UNIVERSITY OF GEORGIA

OUR MISSION

The soybean genetics and development laboratory at UGA is a molecular breeding lab focusing on the development of soybean cultivars for the Southeast US with enhanced productivity, quality, and pest resistance. As of 1996, our soybean genetics lab became the first public breeding laboratory in the U.S that applied molecular marker-based genotyping techniques to effectively accelerate our breeding process. To develop a new variety with high yielding and other important economical traits, the lab uses Qualitative trait locus (QTLs) mapping approach to study the genetics of the trait and identify molecular markers tightly linked to the traits.

Genotyping using SSR markers

Phenotyping in the green-house

Genotyping using SNP markers

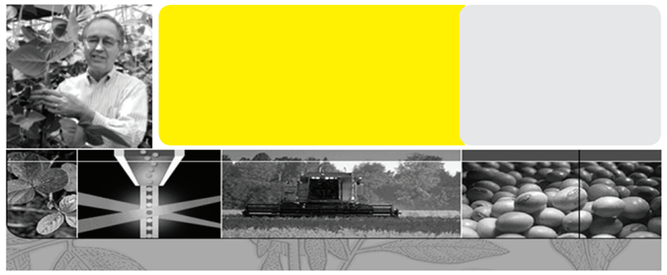
Phenotyping in the field

25 soybean cultivars in Maturity Groups VI -VIII with high yield and resistance to root-knot nematode, red-crown rot , stem canker and frogeye-leaf spot., etc. The Roundup Ready® cultivars released since 2001 dominate soybean production in the lower Southeastern United States .

27 improved soybean germplasm lines with tolerance to soybean cyst nematode and resistance to southern, peanut, and Javanese root-knot nematodes, Asian soybean rust, and defoliating insects. All the traits have associated molecular markers available and ready for use in selection in breeding program.

Anh T. Pham, Email: anhpham@uga.edu, Phone: (001) 706-542-0915 or visit our website at http://mulch.cropsoil.uga.edu/soylab/

SECURE THE FUTURE THROUGH RESEARCH AT THE FOREFRONT OF INNOVATION



With the aid of molecular markers and winter nursery center, our average time of releasing a cultivar is 5-6 years compared to the traditional time of 10 years .

RESEARCH INTERESTS

A. YIELD:

1. Exploit yield QTLs from wild soybean to further improve current soybean yield
2. Develop soybean cultivars with high yielding and other traits of interest

B. INSECT RESISTANCE

1. Lepidopteran defoliators (Corn earworm, soybean looper, velvetbean caterpillar)
2. Coleopteran defoliators (Beetles)

C. NEMATODE RESISTANCE

1. Root-knot nematodes (Meloidogyne spp.)
2. Soybean cyst nematode (Heterodera glycines)
3. Reniform nematode (Rotylenchulus reniformis)

D. DISEASE RESISTANCE

1. Frogeye leaf spot (caused by Cercospora sojinae)
2. Stem canker (caused by Diaporthe phaseolorum)
3. Soybean rust (caused by Phakopsora pachyrhizi)
4. Other diseases (e.g., bacterial pustule, bud blight, etc.)

E. SEED COMPOSITION (TO IMPROVE QUALITY OF SOY-BASED FOODS)

1. Increased protein
2. Modified fatty acid content (mid-oleic acid, reduced palmitic and linolenic fatty acids)
3. Reduced phytic acid4. Lipoxygenase elimination

F. ABIOTIC STRESSES:

1. Drought tolerance, salt tolerance, canopy vigor, chlorimuron ethyl sensitivity, and leaf ash

A soybean line identified with resistance to corn earworm (right) compared to the susceptible soybean line (left). Resistance gene in this soybean line was fine mapped

Our protocol of screening of soybean root-knot nematode in greenhouse is used worldwide

A soybean line identified to be drought tolerant (right) compared to the drought susceptible check (left)

SECURE THE FUTURE THROUGH RESEARCH AT THE FOREFRONT OF INNOVATION

Cartinhour Lab

Plant Pathology and Plant Microbe Biology

US Department of Agriculture

Research

Gene regulation

Technology

Microarray

High throughput sequencing

Application

Plant disease prevention

PATHOGEN RESPONSES TO ENVIRONMENTAL SIGNALS

Bacteria express different behaviors and cause diseases as a response to their surrounding environments. Studying genes involved in the process and how they function is key to control bacteria.

Microarrays were used to identify genes that are regulated in response to changes in iron availability.

Transcriptome and phenotype arrays were analyzed to screen for genes responding to environmental factors.

DISCOVERY OF NOVEL REGULATORY ELEMENTS

Determining locations and functions of promoters, regulatory sites, mall non-coding RNAs is essential to dissecting global gene regulation pathway. RNA - Seq, and 5' end capture were done to provide better understanding of the pathogenesis of Pseudomonas syringae, with the long-term goal of finding new strategies to improve disease management.

COMPUTATIONAL BIOLOGY

Developing computational methods for analyzing large quantities of biological data is important in modern molecular biology where there are complex relationships between factors needed to be analyzed and made sense of.

We have generated and exploited data from CHIP - Seq, RNA - Seq, 5' end capture, or microarray to facilitate the discovery of new regulatory factors and model bacterial gene regulation.

SYSTEMS BIOLOGY

ON PSEUDOMONAS SYRINGAE - A PLANT PATHOGEN MODEL

With the emergence of high throughput sequencing technology, the development of computational methods and the need to look at biological phenomena as a whole, we integrate laboratory and computational approaches to study gene regulation in the model pathogen Pseudomonas syringae

FIGURE 1:
GENES CLUSTERED ACCORDING TO EXPRESSION LEVELS

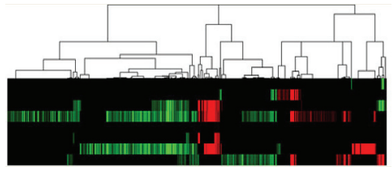


FIGURE 2:
TRANSCRIPTIONAL START SITES AND BINDING SITES ON RNA-SEQ PROFILE

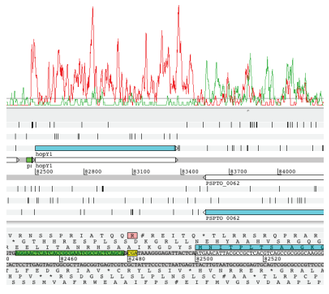
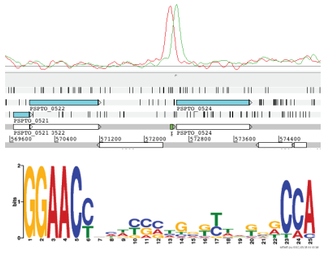


FIGURE 3:
MODELING SIGMA FACTOR MOTIF



Hanh N. Lam, 408 Plant Science, Cornell University, Ithaca, NY 14853, Phone: (607) 255-2160, Email: hnl9@cornell.edu

POSTHARVEST POMOLOGY LABORATORY

- UNIVERSITY OF CALIFORNIA, DAVIS

This is an intense collaboration between a practical postharvest lab of UC Davis and a fundamental biology lab of USDA!

This is an extensive connection among growers, researchers and educational programs to maximize learning and cooperation of people from diverse backgrounds!

Real-time PCR System

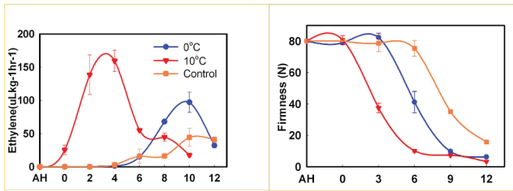
Result → Pear Growers → Funding

POSTHARVEST POMOLOGY LABORATORY

OUR RESEARCH IS DIRECTED AT UNDERSTANDING THE POSTHARVEST BIOLOGY OF FRUIT RIPENING WITH A VIEW TO DEVELOPING PRACTICAL TECHNOLOGY TO IMPROVE FRUIT QUALITY AND SHELF LIFE.

We focus on European pears. Our objectives are:

- Understand how pears develop ripening capacity by identifying genes involved in ethylene signaling pathways.
- Determine pear sensory quality as affected by different harvest and postharvest practices.
- Test Hammock Pack developed specifically for pears to minimize mechanical damage.
- Define the impact of endogenous and exogenous ethylene on the capacity of 1-methylcyclopropene to delay fruit ripening.



Ethylene production and firmness change during pear ripening

Ngoc T. Nham, (1078 Wickson Hall, Department of Plant Sciences, One Shields Avenue, University of California , Davis CA 95616, USA, (1) 530-572-9393, ntnham@ucdavis.edu)

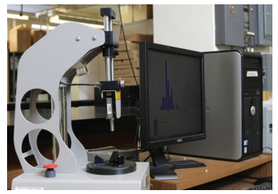
SECURE THE FUTURE THROUGH RESEARCH AT THE FOREFRONT OF INNOVATION

UC DAVIS PLANT SCIENCES

I died as mineral and became a plant,
I died as plant and rose to animal,
I died as animal and I became man.
Why should I fear? When was I less by dying?
Jalal ad-Din ar- Rumi

CROPS PATHOLOGY AND GENETIC RESEARCH UNIT

Much of my work (Objective 1) in molecular biology has been done in this lab. The comprehensive facility laboratory and the attentive mentorship from Dr. Jiang provides us with an excellent environment to understand molecular basis of chilling on fruit ripening.

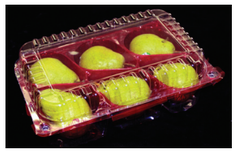


Fruit Texture Analyzer

Chroma Meter

Fruit physiological characteristics are evaluated by fruit firmness, ethylene production, and skin color.

BESIDE PEAR FRUIT, WE ALSO WORK ON OTHER POSTHARVEST ISSUES SUCH AS CALCIUM DEFICIENCY IN APPLES, PESTICIDE FUMIGATION IN TABLE GRAPES.



To accomplish these objectives, we collaborate with Crops Pathology and Genetic Research Unit (USDA), the Department of Food Science & Technology, the Department of Biological & Agricultural Engineering, and AgroFresh, Inc.

ACKNOWLEDGEMENT:
Special thanks to Dr. Elizabeth J. Mitcham, Dr. Andrew J. Macnish,, & Linh T. Pham for reviewing this poster and all their kind support to my work, and to Vu M. Le who helped with photographs.

ABBREVIATION:
UC Davis: University of California, Davis; USDA: United States Department of Agriculture.

PHOTO NOTES:
On the top, from left to right: Molecular Biology Laboratory, Pear tree, and Gas Chromatograph.

CHAPTER 4

APPENDIX

ILLINOIS SYSTEM SECURITY LAB

ANH NGUYEN

An ever increasing amount of the world's wealth and communications are mediated electronically. Unfortunately, modern computer systems are often under attack, making computer security an important topic. Malicious people (called attackers) actively search for computer systems that are vulnerable to attacks. A computer system becomes vulnerable when it contains bugs, or when its user makes a mistake that attackers can exploit to gain unauthorized access. For example, when the user clicks on a web url that leads to a malicious web site or opens a virus sent to him/her via email. Once an attacker gains access to a system, he/she usually tries to steal valuable data such as the victim's identity or his/her online bank accounts.

Our research focuses on two key aspects of computer security: building more secure web browsers and building systems to prevent hardware-based attacks. First, recent evidence suggests that web browsers are currently the most common way for attackers to gain access to current computer systems. The fundamental problem with modern web browsers is the complexity within their design and the complexity of the layers upon which they run (e.g., the operating system).

To combat this problem, we designed a new operating system and new browsers to improve the security of web browsing. Second, computer hardware has become as complex as modern software, leaving future computer systems open to the possibility of hardware-based attacks. To combat this problem, we designed a hardware/software system for removing suspicious circuits from hardware designs automatically and safely. We can take strides towards making current and future computer systems more secure by redefining how we build web browsers and operating systems, and also by rethinking the interactions between hardware and software.

Our research philosophy is that designs for computer systems should be built and evaluated through experimentation. Building systems forces us to make fewer assumptions about the environment in which our systems will run eventually, leading to more realistic information and more meaningful design principles learned from the experiences.

DESIGNING AND IMPLEMENTING MORE SECURE WEB BROWSERS

The ubiquity of Internet access has put a wealth of information and ever-increasing opportunities for social interaction at the fingertips of users. Driving this revolution is the modern web browser, which has evolved from a relatively simple client application designed to display static data into a complex networked operating system tasked with managing many facets of a user's online experience. Support for dynamic content, multimedia data, and third party plug-ins has greatly enriched user's experiences at the cost of increasing the complexity of the browser itself.

As a result, current web browsers are plagued with security vulnerabilities that provide hackers with easy access to end-user systems via browser-based attacks. Browser security efforts to date are essentially retrofits for existing web browsers and have enjoyed only limited success, since the design of modern web browsers are fundamentally flawed.

To address the root of this problem, we've developed an inherently more secure design methodology for any network facing user application, which was validated through the design and implementation of a new secure web browser, called OP, and a new operating system called the Illinois Browser Operating System (IBOS). Our overall design approach combined separation and safety principles from the operating systems community with validation and monitoring techniques developed by the formal methods community. We applied these principles to web browsers and operating systems. The end result was a browser that has formal security measures, the ability to limit the effects of compromised subsystems, and an operating system that reduces the trusted computing base for our browser by 2-3 orders of magnitude when compared to modern web browsers.

Impact: *Our designs for secure web browsers predate the current security efforts by Google, Microsoft, and Mozilla. The key aspects of our designs have been incorporated into their systems. This work on secure web browsers has been written about in print magazines (eWeek and IEEE Spectrum) and has appeared on the front page of Slashdot.*

DESIGNING, IMPLEMENTING, AND DEFENDING AGAINST MALICIOUS HARDWARE

System designers build today's secure systems starting with a set of assumptions. Consequently, one way to break a secure system is to violate these assumptions. For example, when breaking a crypto system, an attacker does not need to target the mathematical underpinnings of the cryptography. Instead, an attacker could look for the encryption keys in memory or tweak the random number generator to make it a little bit less random. By violating these assumptions, an attacker can break the crypto system. One fundamental assumption that underlies secure systems is that the underlying hardware is correct and not malicious. In our research we ask the question "What happens when one can no longer assume that the underlying hardware insusceptible to attacks?" Our goal is to study the design space of hardware-based attacks to learn about how people can use hardware to compromise computer systems and to develop defenses against this threat.

We designed and implemented the first malicious processors (called IMPs) capable of enabling powerful attacks using few additional circuits. We found that malicious processors are more practical, more flexible, and harder to detect than an initial analysis would suggest. Based on what we learned from our experiences designing IMPs, we designed BLUECHIP, a system for detecting and removing suspicious circuits from a design automatically. BLUECHIP's overall goal is to push the complexity of coping with malicious hardware up to a higher, more flexible, and adaptable layer in the system stack.

Impact: *This research has been written about in a print magazine (New Scientist) in addition to appearing on the front page of Slashdot.*

OVERVIEW ABOUT WAVES LAB RESEARCH AND ACHIEVEMENTS

CHINH DANG

Our WAVEs Lab at MSU works primarily on wireless and video communications. There are several NSF projects that we are working on:

DETECTION OF SELF-PROPAGATING MALICIOUS CODE (AWARD ABSTRACT #0430436)

In this project, we developed novel methods for mitigating automated malicious code intrusions (e.g., computer worms). This includes local- and network-level intrusion detection strategies that provide effective and timely detection of malicious codes. The application and performance of the proposed framework in peer-to-peer and mobile ad hoc environments is also being investigated. This work will yield effective defense and detection against automated malicious codes, which have caused profoundly negative impacts on the global internet and users worldwide.

Publications produced as a result of this result:

- Khayam, SA; Radha, H. *"Using signal processing techniques to model worm propagation over wireless sensor networks,"* IEEE SIGNAL PROCESSING MAGAZINE, v.23, 2006, p. 164-169. View record at Web of Science
- S. A. Khayam and H. Radha. *"Modeling Worm Propagation over Vehicular Ad Hoc Networks,"* Society of Automotive Engineers (SAE) Transactions, 2006.

SENSOR DATA GHOSTING: A FRAMEWORK FOR THE SURVIVAL OF CRITICAL DATA UNDER SENSOR FAILURES (AWARD ABSTRACT #0721550)

In this project, we focus on developing a sensor data ghosting framework. The framework creates minimal data redundancy, known as sensor data ghosts. Due to data ghosting, recovery of the sensor data at the sink becomes feasible. In addition, coding and networking solutions are also being developed and integrated in a synergistic manner to achieve sensor data survivability and security. On the networking side, a novel topology evolution solution with the ability of reacting rapidly to random failures and providing expedited delivery of critical data to the sink is being researched. This topology evolution approach rearranges a traditional sensor network geometric topology toward a small-world network topology. In addition to enabling new levels of sensor data survivability, this project has significantly broader theoretical and practical impacts than the target sensor application. This includes the development of new types of "codes on network graphs" and approaches in adaptive network topologies.

- Publication produced as a result of this research:Misra, K; Karande, S; Radha, H. *"Maximal Recovery Network Coding Under Topology Constraint,"* IEEE TRANSACTIONSON INFORMATION THEORY, v.56, 2010, p. 6317-6331.

SOCS: SIGNAL PROCESSING AND INFORMATION THEORETIC APPROACHES TO DENOISING AND DEMYSTIFYING SOCIAL NETWORK SERVICES (AWARD ABSTRACT #0968495)

The objective of this project is to develop in-depth understanding of the nature, underlying models, and dynamics of Social Network Services (SNS) with millions and even billions of users. We use signal processing and information-theoretic techniques for the analysis of massive SNS graphs. This research enables a spectrum of novel applications that are currently impossible. A deeper understanding of the structure of social networks and how that structure evolves can be applied to a variety of social issues. The project is interdisciplinary in nature and it bridges several different communities including ***electrical engineering, computer science,*** and ***social science***; and it fosters interaction and communication among them. To promote education and learning, this project actively engages high school, undergraduate, and graduate students, especially students from under-represented minorities.

Publications as a result of the project:

- M. Zubair Shafiq and Alex X. Liu. *"A Random Walk Approach to Modeling the Dynamics of the Blogosphere,"* Proceedings of the International Conferences on Networking (Networking), Valencia, Spain, May 2011., 2011.
- Muhammad U. Ilyas and Hayder Radha. *"Identifying Influential Nodes in Online Social Networks Using Principal Component Centrality,"* Proceedings of the IEEE International Conference on Communications (ICC'11), Kyoto, Japan, June 5-9, 2011., 2011.
- Muhammad U. Ilyas, Zubair Shafiq, Alex X. Liu and Hayder Radha. *"A Distributed and Privacy-Preserving Algorithm for Identifying Information Hubs in Social Networks,"* Proceedings of the 30th IEEE Conference on Computer Communications (INFOCOM'11) Shanghai, China, April 10-15, 2011., 2011

In addition to NSF projects, we are working in collaboration with some leading imaging companies such as ***Kodak Research Labs*** and ***Technicolor*** in some research topics like compressed sensing or video compression. In particular, we are working on improving consumer digital cameras. We apply some recent results in the emerging field of compressed sensing to replace traditional Color Filter Array (CFA) in consumer video by a random panchromatic CFA. In my project, I also work with consumer (or user-generated) video but focus on video compression. With the rapid development of consumer video, the research in video retrieval and indexing is also very potential. Some out-standing results (For a full list of papers, please visit our lab web-page: ***http://www.egr.msu.edu/waves/index.html***).

- Abdolreza Abdolhosseini Moghadam, M. Aghagolzadeh, H. Radha and M. Kumar, *"Incoherent Color Frames for Compressive Demosaicing",* IEEE ICASSP 2011.
- Abdolreza Abdolhosseini Moghadam, M. Aghagolzadeh, H. Radha and M. Kumar, *"Compressive Demosaicing"*, IEEE MMSP 2010 (top 10 paper award).
- Abdolreza Abdolhosseini Moghadam and Haydar Radha, *"Hybrid Compressed Sensing",* IEEE MMSP 2010.

BIOCHIPS

– A PROMISING DIAGNOSTIC TECHNOLOGY FOR GLOBAL HEALTH

HOAN NGO

Disease diagnosis plays an important role in improving healthcare quality. In developed countries, diagnostic procedures are usually conducted in advanced central laboratories by highly trained personnel. However, current analysis of samples for detecting diseases is still very time-consuming, taking hours to days. The situation is worse in developing countries where most of central laboratories are located in a few large cities and are in short supply of reagents, equipment, and trained personnel. Patients in remote areas of developing countries usually have to go to large cities to have diseases diagnosed, which often results in serious overloaded health management situations at central hospitals. For infected patients who are not able to go to these central hospitals, their chance to get diagnosed accurately is out of reach. Therefore, there is a critical need to develop accurate, rapid, simple-to-use, disposable, and point-of-care (POC) diagnostic devices that can be used in remote areas with limited resources. Such POC diagnostic devices would improve the health of millions people in the most disadvantaged regions of the world, allow them to benefit from the latest advances in biomedical technology. Furthermore, POC diagnostic devices could also enhance healthcare quality in developed countries by significantly decreasing diagnostic time from hours or days to matter of minutes, leading to early and effective treatment. For diseases where time is critical, this could mean the difference between life and death. Moreover, POC diagnostic devices could be used at port-of-entries for national security purposes, in case of epidemic, e.g. influenza, in military operations, or in home healthcare. Designing such devices is actually an opportunity for scientists and engineers to utilize their intellect, skills, and tools to bridge the gap between existing technologies and the important demands of global health.1

The World Health Organization (WHO), in an effort to improve diagnostic devices for the developing world, has identified attributes which these devices should have. These attributes, referred to as the "ASSURED" criteria, include: Affordable, Sensitive, Specific, User-friendly, Rapid and robust, Equipment free, and Deliverable to end-users.2 To meet the above criteria, the Biochip or Lab-on-a-Chip emerges as a promising technology. Biochips involve integration between microfluidic technology and biosensor technology, which has developed for several last decades. This technology could result in diagnostic devices that are small, practical, low-cost, and easy to use with disposable probes for point-of-care applications, while still maintaining sensitivity and specificity similar to instruments at central laboratories. Recent successes in this active field of academic research include: a stand-alone self-powered integrated microfluidic blood analysis system3 (SIMBAS) which can perform five complete biotin–streptavidin sample-to-answer assays in 10-min with the limit of detection of 1.5 pM; an 'mChip' assay4 which can diagnose HIV using only 1 ml of unprocessed whole blood and an ability to simultaneously diagnose HIV and syphilis with sensitivities and specificities that rival those of reference benchtop assays. Microfluidic paper-based analytical devices (μPADs) made of paper and wax are recently introduced.5 Many other progresses can be found in critical reviews published recently.6,7

Vietnam is a developing country going through intense industrialization. Exhaust and wastes from industry and cities are increasingly polluting the air, soil, and water, creating potentially hazardous effects to human health. In addition, clean water shortage in remote areas and unsanitary living practices are also important factors. Among many actions that need to be taken, the development of a biomedical device industry, of which diagnostic devices are an integral part, is essential to improve healthcare for Vietnamese people.

With the goal of contributing to the development of biomedical device industry in Vietnam, I decided to enroll as a PhD student in Biomedical Engineering at Duke University and a member of Professor Tuan Vo-Dinh's research group, thanks to the support from Vietnam Education Foundation. Professor Tuan Vo-Dinh is director of Fitzpatrick Institute for Photonics, professor of Biomedical Engineering and of Chemistry at Duke University.8 He is one of the US leading experts in developing novel technologies for medical and environmental applications. He has developed a multifunctional biochip for medical diagnostics and pathogen detection.9

Our goal is to develop a new stand-alone and integrated biochip capable of diagnosing infectious diseases at point-of-care settings. Such a biochip will help relieve the effects of infectious diseases in Vietnam as well as in developing countries in general. According to data from Vietnamese Ministry of Health, the most common infectious diseases in Vietnam in recent years are influenza, diarrhea, petechial fever, hand-foot-and-mouth disease, mumps (parotitis), chickenpox, malaria, HIV/AIDS, streptococcus swine, etc…During the first seven months of 2011, there are nearly 29,000 petechial fever cases in Vietnam which cost 28 lives. For hand-foot-and-mouth disease, by September 2011, there are nearly 43,000 cases which cost 98 lives.11 In the world, infectious diseases are still important causes of death (Figure 1). Impact of different infectious diseases to disability-adjusted life years (DALYs) is shown in Figure 2. Developing a biochip for diagnosing such infectious diseases could save many lives not only in Vietnam but also in the world.

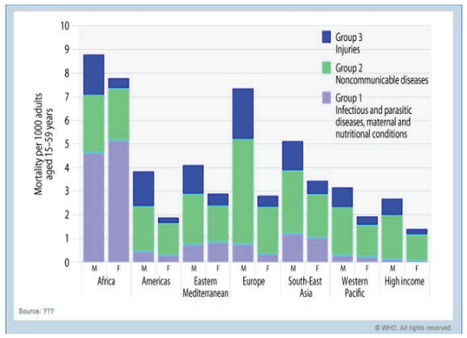


Fig. 1 Causes of death in men and women ages 15-59 years by region, 2008 (figure from WHO).

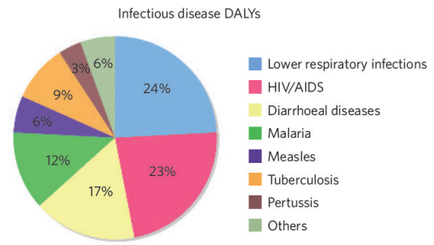


Fig. 2 Disability-adjusted life years (DALYs) for infectious and parasitic diseases, 2005 (figure from Ref. 10)

1. Paul Labara, David Boyle, Kenneth Hawkins, Bernhard Weigl, *Instrument-free nucleic acid amplification assays for global health settings*, Proc. of SPIE Vol. 8029 802902, 2011.

2. R W Peeling, K K Holmes, D Mabey, A Ronald, *Rapid tests for sexually transmitted infections (STIs): the way forward*, Sex Transm Infect 2006;82(Suppl V):v1–v6.

3. Ivan K. Dimov et al., *Stand-alone self-powered integrated microfluidic blood analysis system (SIMBAS)*, Lab on a Chip, 2011, 11, 845–850.

4. Curtis D Chin et al., *Microfluidics-based diagnostics of infectious diseases in the developing world*, Nature Medicine, Vol. 17, No. 8, August 2011.

5. Andres W. Martinez, Scott T. Phillips, and George M. Whitesides, *Diagnostics for the Developing World: Microfluidic Paper-Based Analytical Devices*, Analytical Chemistry, Vol. 82, No. 1, January 1, 2010.

6. Daniel Mark, Stefan Haeberle, Gunter Roth, Felix von Stetten and Roland Zengerle, *Microfluidic lab-on-a-chip platforms: requirements, characteristics and applications*, Chem. Soc. Rev., 2010, 39, 1153–1182.

7. Seokheun Choi, Michael Goryll, Lai Yi Mandy Sin, Pak Kin Wong, Junseok Chae, *Microfluidic-based biosensors toward point-of-care detection of nucleic acids and proteins*, Microfluid Nanofluid, June 2010.

8. Vo-Dinh research group ***http://www.vodinh.pratt.duke.edu/***

9. Tuan Vo-Dinh, Guy Griffin, David L Stokes, Alan Wintenberg, *Multi-functional biochip for medical diagnostics and pathogen detection*, Sensors and Actuators B: Chemical, Volume 90, Issues 1-3, 20 April 2003, Pages 104-111.

10. Paul Yager et al., *Microfluidic diagnostic technologies for global public health*, Nature, Vol. 442|27, July 2006.

11. ***http://www.voh.com.vn/News/NewsDetail.aspx?id=35849***

NEW METHODS TO ACCELERATE BRIDGE CONSTRUCTION

HUNG V. TRAN

The bad news is that traffic delays are getting worse. Construction exacerbates traffic congestion. The huge highway systems of the US, which were started in the early 1900s and completed in 1970s, are going to be overwhelmed in the near future. By the year 2020, ninety percent of the urban Interstate highways will be at or exceeding capacity.

The good news is that Highways for LIFE program (HfL) of the U.S Federal Highway Administration is finding solutions. One of them is reducing congestion caused by construction by using Accelerated Bridge Construction technologies (ABC).

University of Washington graduate students Olafur Haraldsson, Todd Janes, and Hung Viet Tran are working with Professors John Stanton and Marc Eberhard on ways to speed up the construction of bridges by using Prefabricated Bridge Elements and Systems. Using precast bridge elements is one solution for reducing on-site construction time, field labor requirements, and traffic.

Although large substructures (and even, full bridges) can be constructed off site, precast elements are usually beams and columns used to make fabrication and transportation easier. The quality of the individual precast elements cast in a factory often exceeds the quality of elements cast in the field. However, the construction quality of on-site connections between these precast elements is more difficult to achieve. Achieving good connections is particularly challenging in seismically hazardous areas, like the Pacific Northwest, in which the largest forces are developed at the beam-tocolumn or column-to-footing connections.

Therefore, it is vital to develop economical connections that are strong enough to resist seismic excitation and easy to construct with high quality.

PRECAST BRIDGE ELEMENT CONCEPT

A lot of research has been performed on precast bridge connections, but mainly for applications in which the seismic demands are low (e.g. Matsumoto et al. 2001, FHWA 2004). Less research has been performed for applications in seismically active regions. Hieber et al. (2005a) summarizes the state of the art in this area in 2005. Since then, Hieber et al. (2005b) performed numerical analysis of precast piers, and Wacker et al. (2005) developed displacement and force-based design procedures.

In 2008, Pang et al. proposed using “Large-Bar” connections to connect beams and columns. They proposed to connect the elements with a small number of large bars that would fit into large ducts. Steuck et al. (2008, 2009) showed that bars as large as #18 could be anchored within the typical depth of a cap beam. Cohagen et al. (2008) later proposed using un-bonded post-tension strands to help re-centering the column after an earthquake. In 2011, Matsumoto et al. summarized the development of a precast concrete bent-cap system for seismic regions. Haraldsson et al. (2011) developed the idea of using a socket connection to connect the base of a precast column with a castin-place spread footing. Later, Hung Tran et al (2011) adapted the idea of socket connection to the connections between a precast column and cast-in-place drilled shaft, which has a lot of benefit in bridge construction in urban areas. In this connection, the bottom of the precast column is roughened, where it will be embedded in the drilled shaft.

Further tests on the complete connection showed performance at least as good as that associated with conventional cast-in-place construction. Work is continuing to extend these ideas to provide seismic performance that is expected to exceed that of conventional cast-in-place construction, while still maintaining the benefits of rapid construction.

Washington State DOT has just approved a contract to build a bridge over I-5 using the technology.

For further information regarding the labs referred to in the essay, please access:

1. ***http://www.plantsciences.ucdavis.edu/PlantSciences_Faculty/mitcham/*** (The content will be updated soon.)
2. ***http://bpp.oregonstate.edu/sugar***
3. ***http://www.ars.usda.gov/pandp/people/people.htm?personid=40802***

A TALE OF PEAR RIPENING

NGOC T. NHAM

THIS ESSAY DESCRIBES MY CURRENT RESEARCH AND IS SPECIFICALLY WRITTEN FOR GENERAL AUDIENCES WHOSE SPECIALTIES MIGHT NOT BE IN BIOLOGY/AGRICULTURE. THE IDEA WAS ORIGINALLY FROM MY LAYMAN SUMMARY IN THE PLANT AND MICROBE INTERACTIONS COURSE. THANKS TO ANDREW J. MACNISH FOR BEING A SHARP CRITICIZER. (N. T. N., 2011)

Suppose that... you bought some 'Comice' pears (a type of European pears) at a grocery store. Unfortunately, the pears remained green, hard as a rock and developed no flavor even after one week in the kitchen. Ideally, European pears should be ready to eat when they are ripe: soft, buttery and flavorful. Did you know if there was something you could do to make these pears edible?

If you were not sure, typing 'how to...' on Google.com should have given you a right answer. But let us play a game with your kid (imagine that you have one, either son or daughter) to have some more fun. You can take half of the pears into a fridge and leave the remaining half on a kitchen bench. After some days, the pears from fridge are transferred to a kitchen bench. One day not so long from that day, your kid may notice:

- Some pears are soft. They are ripe, Mom (or Dad)! ... I am wondering why the pears can ripen even though they are not on trees. The Fairy Godmother with a magic stick came out from the Cinderella?
- That is a very interesting idea. If that had been the Fairy Godmother, we should have heard Bibbidi-Bobbidi-Boo*. My answer is: because pear is a ***climacteric*** fruit, which can still ripen after leaving the tree, in contrast to ***non-climacteric*** fruit. A gas named ***Ethylene*** makes the difference between these two fruit types. This gas is actually produced inside ***climacteric*** fruit and has ability to turn all of the fruit including pears, tomatoes, and bananas from green to ripe, the ones we prefer. ***Ethylene*** has no effect on ***non-climacteric*** fruit. Therefore, you can consider ethylene as a nice gift from the Fairy Godmother.
- Does it mean that the ethylene has been produced in the soft pears but not in the hard ones?
- You should remember what I have done with the ripe pears.
- Did you keep them in the fridge for some days?
- Good point! We will see if a more-in-depth answer can be found from research work in the Postharvest Pomology Laboratory [1] at the University of California at Davis in the U.S.

Before we begin talking about their scientific work, we should understand some biological terms: a ***Gene*** is a ***Soldier***, and a ***Transcription factor*** is a ***General***. In biological processes, Transcription factors - Generals are very important because they lead a group of Genes - Soldiers to complete their missions. In order to make pears ripen, particular Generals and Soldiers will synthesize a special energy source. This energy source is beneficial only at room temperature (not lower than 20°C).

From previous study, many genes involved in the ethylene synthesis have been identified. Tracking the activity of the genes provides researchers ideas of how the ripening process happens. The more active they are, the larger energy source is built. If the energy level is high enough, ethylene produced can make fruit ripen at room temperature. The higher the level is, the more quickly the fruit ripen.

"The Fairy Godmother's song in the Cinderella movie"
Walt Disney, 1950

In this post-harvest lab, their study has found that low temperatures (not higher than 15°C) stimulate activities of the genes. Therefore, the cold treated pears might have an energy source that is large enough to develop ripening when they are transferred to room temperature. Meanwhile, the untreated pears have no or very little of this energy and cannot ripen. This is a reason for our pears. Interestingly, the characteristic of cold conditioning in pears has not been found in other climacteric fruit, probably except kiwi fruit.

Moreover, the researchers also proved that the genes were very active at 10°C, compared with either lower or higher temperatures. Hence, if green pears are stored at 5, 10, or 15°C for the same time length, the fruit from 10°C will ripen the most rapidly at a room condition.

However, the transcription factors that control ethylene production genes are still unknown. Hopefully, they will be clarified in further research. This understanding is to achieve the ultimate goal of predicting how long it will take one pear to ripe, less or more than one week. This will help the farmers know the right time to pick their fruit, the supermarket know the right time to sell their fruit.

- What an amazing scientific world!
- Definitely! You should learn one more thing: the researchers at the UC Davis have very good connections with the pear industry and other researchers from Pacific Coast including Oregon State University [2], as well as from the United States Department of Agriculture [3]. These organizations provide support through funding, facilities, and very helpful suggestions to their work.

After hearing this tale, I am pretty sure that you can not stop your kid from realizing: "To be a plant scientist is extremely cool!!!"

Davis, 18th September 2011

ESSAY

PHAM TUNG ANH

Welcome to the soybean genetics and development laboratory (SGDL) located at the University of Georgia (UGA). The laboratory was founded in 1973 and directed by Dr. Roger Boerma, a distinguished professor of Soybean Breeding and Genetics at UGA. The ultimate goal of the laboratory is to develop soybean cultivars for the Southeastern United States with enhanced productivity, quality, and pest resistance. Currently, the lab has 11 full-time employees which are divided into two units : molecular lab and seed lab. The personnel in seed lab are in charge of preparing and performing all activities involving planting and harvesting in both green house and all field locations. In addition to the seed lab stores and provide seeds for all research projects.

The personnel in molecular lab are in charge of identification, development of molecular markers associated with each soybean traits, and helping with selection of soybean individual plants carrying the genes of interest in a specific breeding program. With an average of a 1.1 million dollar budget annually, the lab has its research projects encompassing multiple areas: yield, insect and nematode resistance, seed traits, disease resistance and abiotic stresses. As of 1996, the lab has used molecular markers (restriction fragment length polymorphism (RFLP), Simple Sequence Repeats (SSR) and recently SNP (single nucleotide polymorphism) markers) in the research and breeding programs. With the application of molecular markers and winter nursery in Puerto Rico, the breeding program conducted is tremendously accelerated and effective. The last 38 years, Dr. Roger Boerma and his students and colleagues have released 25 soybean cultivars with high yielding and resistance to either soybean nematodes or soybean diseases such as stem canker, frogeye leaf spot, etc. The soybean cultivars developed from SGDL have been grown in more than 100 million acres in Georgia, North Carolina, South Carolina and Mississippi. The lab also released 27 improved soybean germplasm lines with tolerance to soybean cyst nematode and resistance to southern, peanut, and Javanese root-knot nematodes, Asian soybean rust, and defoliating insects. All the traits have associated molecular markers available and ready for use in selection in breeding program. Our lab is proud that many of the phenotyping protocols designed from SGDL are being used in other soybean lab domestically and internationally such as screening in greenhouse for root-knot nematode and soybean cyst nematodes. The lab also has a tight collaboration with the industrial sector and has been providing phenotyping service for private companies. Ultimately, the labs and its scientists aimed at providing soybeans with high yield and better seed quality or higher resistance to soybean diseases for the next generation.

SOME INTERESTING ACHIEVEMENTS IN COMPUTER VISION

THANG DINH

Have you ever dreamed to make a robot that can think and behave like humans? Have you ever thought about having a car that can automatically run by itself and get to anywhere you want? I have had this dream since I was an 8-years-old kid who could not keep my eyes off of the movie "Terminator 2." As time goes by, those interesting and ambitious ideas have been well-demonstrated in the theaters such as: Tom Cruise controlling a complicated system using his bare hands in Minority Report (2005) or more recently Shia Labeouf being detected and chased by a network of cameras in Eagle Eye (2008). Doing research in Computer Vision for the last seven years, sometimes I wondered myself if those "miracles" could come true. And here they go.

First, I want to emphasize the emergence of 3D sensors from which Kinect, a sensor invented by PrimeSense, is one of the stand-out products worthy to be named. Most of people might think of Kinect as a gaming kit coming along with XBox 360 console produced by Microsoft, where it is presented currently. However, let's think about how much impact it can provide: controlling computers using bare hands as in Minority Report? Easy! Building 3D models of the world? Not hard anymore! The emergence of 3D sensors not only changes the entertainment trend but also the research. For those, who have not known about Kinect, please follow: ***http://www.youtube.com/watch?v=Mf44bWQr3jc***

Second, I want to name the technologies related to faces. The invention of face detection methods by Viola and Jones has changed the world. Thanks to that incredible breakthrough, we can have a face detection mode in our pocket cameras, a facial expression avatar system in some instant messengers, and so on. Or another obvious and popular example is the automatic detection and tagging tool integrated to Facebook to make our life much easier. For ones who want to try cool stuffs of face recognition, please follow: ***http://face.com***

Third, I want to introduce the visual tracker. Having been working on tracking topic for the last 5 years, many times I questioned myself if there could be such a method to come in the future. And it did come. If you want to have such a tracker which is able to follow any type of objects as long as it appears in the frame, please follow: ***http://www.youtube.com/watch?v=1GhNXHCQGsM*** and our just-released tracker allows to differentiation between similar objects: ***http://iris.usc.edu/people/thangdin/research.html*** You can download and play with the webcam version included in the package. We have ported our algorithm on an active camera system which can pan, tilt, and zoom to follow the face of the person of interest wherever he goes. And I believe the day when there are some tracking systems as seen in Eagle Eye (2008) will come soon.

Last, it will be a big mistake if I do not discuss about the visual search technology. Have you ever had a problem when you come to a bookstore, try to pick a novel, but have no idea if it is good or not. Usually, people often choose the authors that they are already familiar with. Now, things have changed. You can just take the photo of the products using your phone and you will have the reviews of that product. One example you might want to try is the Snaptell: ***http://www.snaptell.com/***

It is obvious that there are many other promising and interesting achievements in computer vision, I would like to stop here; otherwise it might take many days just to discuss some cool ideas that have been developed. With the fast development in technology, a camera can be purchased anywhere with very low price. It has also been integrated to mobile phones for several years, which can guarantee us about the coming of a new era of technologies related to computer vision. Imagine that, when you come home, it can recognize you and open the door. When you want to control any electrical items in your house, just use your bare-hand, and when you want to drink something just order the robot. That day will come soon! Here is the last video I want to include, hope that you can get inspired from how far the technologies have already reached and how far they can go: ***http://www.youtube.com/watch?v=mUdDhWfpqxg***

HIGH THROUGHPUT EXPERIMENTATION LABORATORY FOR ORGANIC SYNTHESIS

TRUNG CAO

The High Throughput Experimentation (HTE) laboratory is a joint research facility emerging from the collaboration between Merck and the Department of Chemistry at the University of Pennsylvania and among the first three HTE centers in US outside the industrial agrochemical and pharmaceutical environment.

The HTE laboratory offers students and postdoctoral researchers a very powerful tool for rapid reaction development or rapid discovery of new catalytic systems. With a collection of many catalysts and targets, it is extremely time consuming and requires a lot of effort to determine the reactivity of each catalyst toward the lead substrates along with optimization of the reaction conditions. To speed up this process from discovery to understanding, optimization and implementation, HTE is a paradigm changing technology allowing simultaneous assessment of different reaction conditions by means of 24- or 96-well reaction plates and automated screening of the reaction products. This approach allows a deeper understanding of the reaction to be obtained, which is vital for optimization and expanding fundamental chemical knowledge. Moreover, this strategy goes beyond hit-and-miss approaches since it enables one to capture all the data generated. The goal of HTE is not to reduce the number of experiments (in contrast, this number may well increase) but to carry experiments at a faster rate and ideally screen them in parallel consequently to compact the time penalty otherwise associated with the large numbers of unsuccessful experiments. Moreover, by facilitating micro-scale reactions, HTE reduces the consumption of valuable reagents and minimizes the waste of screening process.

Some ongoing projects at THE laboratory are:

- Oxidative coupling reactions of phenols and napthtols
- Organometallic reactions with organotrifluoroborates
- Development of nitro compounds

An example of applying HTE in organic synthesis can be found in this article “Palladium-Catalyzed, Direct Boronic Acid Synthesis from Aryl Chlorides: A Simplified Route to Diverse Boronate Ester Derivatives”, *Journal of American Chemical Society*, DOI: 10.1021/ja1089759.