University of Illinois at Urbana-Champaign
Innovation & Start-Up Showcase

SHARE THE VISION

SEPTEMBER 21 2017

ILLINOIS

Program of Events

SHARE THE VISION · SEPTEMBER 21, 2017

University of Illinois at Urbana-Champaign Innovation & Start-Up Showcase

Hosted by the Office of Technology Management and the University of Illinois Research Park

Research Presentation

PAUL HERGENROTHER

Chemistry, Carl R. Woese Institute for Genomic Biology, Carle Illinois College of Medicine

RESEARCH

Using organic compounds to identify novel cellular targets that can be exploited in the treatment of diseases including cancer and drug-resistant bacteria.

HONORS

Kenneth L. Rinehart Jr. Endowed Chair in Natural Products Chemistry; Arthur C Cope Scholar Award, 2017; UCB-Ehrlich Award for Excellence in Medicinal Chemistry, 2016

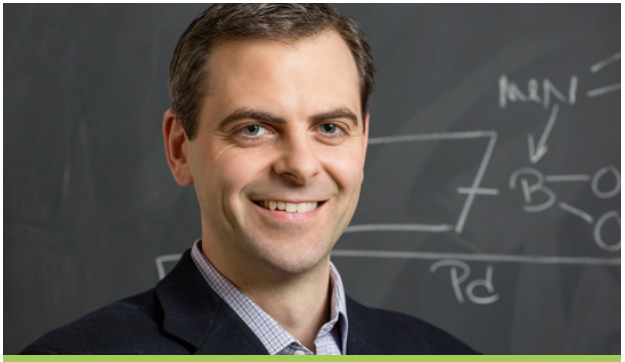
START-UP COMPANY

Vanquish Oncology: targeting unexploited molecular defects in cancer cells to create first in class, personalized therapeutics for unmet or underserved cancer markets. The company's Procaspase Activating Compound-1 (PAC-1) is currently in Phase I clinical trials. *vanquishoncology.com*

TALK: Novel Anticancer and Antibacterial Drugs, for Pets and People

Only a small percentage of compounds that begin human clinical trials end up becoming approved as a drug. For anticancer drugs, this success rate is as low as 1 in 20. A major reason for this lack of success is the traditional development pathway, whereby efficacy is assessed in rodent models, and the next efficacy assessment is in people.

Together with collaborators at the UIUC Department of Veterinary Medicine, we have been working to assess candidate compounds in pets with cancer as a way to help these veterinary cancer patients that often have no other options. Through this work we have advanced one compound into clinical trials in human cancer patients, and another is close behind. This discovery paradigm, and its application to novel broad-spectrum antibiotics, will be described.(*Nature*, 2017)



Research Presentation

MARTIN BURKE

Chemistry, Carle Illinois College of Medicine

RESEARCH

Development of molecular prosthetics as a general strategy for the understanding and improvement of human health where small molecules with the capacity to perform protein-like functions can serve as substitutes for missing or dysfunctional proteins

HONORS

American Chemical Society Nobel Laureate Award for Graduate Education, 2017; Thieme-IUPAC Prize in Synthetic Organic Chemistry, 2014

START-UP COMPANIES

Revolution Medicines: harnessing frontier cancer targets through exceptional drug discovery inspired by nature's lessons. Revolution Medicines was named a 2015 "Fierce 15" Biotech Company. *revolutionmedicines.com*

Kinesid Therapeutics: focusing on small molecule therapeutics to treat iron deficiencies.

TALK: Molecular Prosthetics to Treat Anemia and Cystic Fibrosis

My lab pioneered the burgeoning field of molecular prosthetics – small molecules that partially replicate the functions of missing or dysfunctional proteins that underlie a wide range of currently incurable human diseases. For instance, we recently found that a natural product isolated from the hinoki tree in Japan, called hinokitiol, can replace missing iron transporting proteins in yeast, mammalian cells, and cultured human gut epithelia as well as rescue gut uptake in mice and rats and hemoglobinization in zebrafish (*Science* 2017). Clinical trials are now being targeted in genetically-defined patients with loss-of-function mutations in the iron transporter ferroportin (Ferroportin disease).

We also recently discovered that a different small molecule can replicate the function of CFTR anion channels in cultured primary human airway epithelia from genetically diverse cystic fibrosis patients. Clinical trials are currently being targeted to test this genotype-agnostic approach for treating cystic fibrosis.

In both of these cases, we found that imperfect functional mimicry of missing proteins can be sufficient to vigorously restore physiology. We also demonstrated that this remarkable tolerance for imperfection is attributable to functional integration of these small molecules into inherently robust protein-based networks, akin to bionic molecular systems. Our studies have thus yielded a new way to potentially treat a wide range of currently incurable human diseases caused by loss of protein function.

Research Presentation

ADITI DAS

Comparitive Biosciences, Beckman Institute for Advanced Science & Technology

RESEARCH

Elucidating the biochemical mechanism of the enzymes in the epoxygenase (EPOX) pathway and studying the biological role of the novel anti-inflammatory ω-3 and ω-6 fatty acid epoxides. Also, the study of endocannabinoid metabolism by cytochrome P450 leading to the discovery of novel endocannabinoid epoxides that are anti-inflammatory and vasodilatory.

HONORS

ChemistrySelect editorial board, 2016; National Scientist Development Award, American Heart Association, 2015

TALK: Endocannabinoid Derivatives as Novel Anti-Inflammatory and Anti-Pain Drugs

Cannabinoids are found in marijuana and endocannabinoids are produced naturally in the body from ω-3 and ω-6 fatty acids. Endocannabinoids are ligands for cannabinoid receptors 1 and 2 (CB1 and CB2). CB1 agonists exhibit psychotropic properties while CB2 agonists have anti-inflammatory effects. Consequently, there is a strong interest in the discovery of CB2-selective agonists to mitigate inflammatory pathologies, including pain.

Our laboratory has reported that a cascade of enzymatic reactions convert ω-3 fatty acids into anti-inflammatory endocannabinoid epoxides that act through the same CB receptors in the body as marijuana. These dual functional ω-3 endocannabinoid epoxides exhibit preference towards binding to CB2 receptor and are anti-inflammatory and vasodilatory and reciprocally modulate platelet aggregation. By virtue of their physiological properties, they are expected to play important roles in neuroinflammation, cerebrovascular diseases such as stroke, and in pain. We have designed stable derivatives of these naturally occurring endocannabinoid epoxides that produce some of the same medicinal qualities as marijuana such as reducing inflammation and pain, but without a psychotropic effect. (*Proceedings of the National Academy of Sciences*, 2017)

Research Presentation

ZEYNEP MADAK-ERDOGAN

Food Science and Human Nutrition, Carl R. Woese Institute for Genomic Biology

RESEARCH

Using systems biology approaches to understand how hormones and nutrition affect women's health, in particular the molecular basis of how breast tumors become deadly and the impact of synthetic and botanical estrogens on metabolic health of postmenopausal women.

HONORS

ENDO Early Investigators Award, 2015; Arnold O. Beckman Award, 2015; Women in Endocrinology Young Investigator Award, 2011

TALK: Designer Estrogens: New Opportunities for Improving Postmenopausal Women's Health

Due to longer life expectancy and increasing population of women reaching menopause age, more women experience metabolic problems and increased weight gain as estrogen levels decrease after the onset of menopause. Increased obesity elevates the risk of heart disease, stroke, uterine and breast cancers. Currently, estrogen hormone replacement therapy (HRT) is prescribed to women who have clinical symptoms, for the shortest possible time and at the lowest possible dose because of the risk of breast and uterine cancers. So there is an urgent need to find safer HRT alternatives to ensure that women can lead healthy lives after menopause.

We developed novel estrogens that retain beneficial effects in metabolic tissues without further risks to reproductive tissues. We will present our recent findings on how these designer estrogens impact ER actions in the nucleus in breast cancer and in metabolic syndrome associated with menopause. (*Science Signaling*, 2016)

Start-Up Presentation

DANIEL SCHMITT

University of Illinois at Chicago Start-Up

EXPERIENCE

Mr. Schmitt brings 30 years of successful industry experience having held senior executive positions in both large pharmaceutical and small biotechnology companies, including Genus Oncology LLC, Searle/ Pharmacia, and Ilex Oncology. During his career, he has led and contributed to the successful development and launch of over 12 pharmaceutical products.

START-UP COMPANY

Actuate Therapeutics: a Chicago-based biopharmaceutical company focused on the development and commercialization of novel therapeutics for high impact cancers and inflammatory diseases. The company is led by a senior management and scientific team with decades of pharmaceutical industry experience leading successful discovery, development, and commercialization of new therapeutic agents and health related technologies.
actuatetherapeutics.com

TALK: Actuate: Advancing Research to Treatment of Cancer and Inflammatory Diseases

Actuate Therapeutics, Inc. is focused on the development of compounds for use in the treatment of cancer, and inflammatory diseases leading to fibrosis and neurodegeneration. Actuate was founded in 2015 with a mission of discovering, developing, and commercializing new agents that target GSK-3β, based on intellectual capital developed in the laboratories of the University of Illinois-Chicago and Northwestern University.

We are currently advancing our lead molecule, 9-ING-41, towards the clinic, with an IND filing targeted in 2017. Ongoing research has demonstrated significant anti-tumor activity in many in vivo models of difficult to treat cancers, including cancers of the brain, pancreas, lung, and breast. Our research has demonstrated that our technology is Best in Class, with significant efficacy in treatment-resistant cancers and fibrotic diseases. The toxicity and pharmacokinetic profiles of the drug candidate are quite attractive.

Research Presentation

STEVEN ZIMMERMAN

Chemistry

RESEARCH

Developing compounds that can: (1) serve as DNA or RNA-targeted therapeutic agents, (2) function as stable and biocompatible imaging agents, (3) act as encapsulants to carry active agents and deliver them in a stimuli-responsive manner, and (4) deliver drugs or cells specifically to diseased tissue. Students in our group can learn a range of skills from organic synthesis and chemical biology to computer modeling and advanced materials development and characterization.

HONORS

Fellow, American Chemical Society; Fellow, American Association for the Advancement of Science; Arthur C. Cope Scholar Award, American Chemical Society (ACS)

TALK: Targeting the DNA and RNA That Causes Disease Using Small Molecules and Polymers

This talk will focus on the design, synthesis, and study of ligands that target DNA and RNA repeat sequences that cause disease. The design aspect involves a rational approach using simple principles of supramolecular chemistry. Regarding the targets, most of the discussion will be on the DNA and RNA sequences that cause myotonic dystrophy type 1 (DM1), these involving repeating sequences containing mismatched base-pairs. The application of the general strategy will also be discussed in the broader context of other potential targets.

Considerable focus will also be on: (1) multi-target drug design, i.e., drugs designed to impact more than one part of the disease pathobiology, (2) polyvalent drug design for increasing affinity and selectivity of the therapeutic agents and (3) strategies for delivering the active agents to cells either through in situ assembly or delivery vehicles. Strategies for assembling active agents within cells that are being pursued include template-assisted synthesis and the nanoparticle-catalyzed construction of complex structures.

Research Presentation

ANDREW FERGUSON

Materials Science and Engineering

RESEARCH

The investigation of equilibrium and dynamic properties of soft matter, with specific foci in the self-assembly of biological and bioinspired materials, machine-learning accelerated molecular dynamics, inference of protein folding landscapes from experimental data, and the reconstruction of viral fitness landscapes for computational vaccine design.

HONORS

Dean's Award for Excellence in Research, 2017; AIChE CoMSEF Young Investigator Award for Modeling & Simulation, 2016; American Chemical Society COMP OpenEye Outstanding Junior Faculty Award, 2015

TALK: Data-Driven Computational Vaccine Design

Despite decades of research, no vaccines are yet available for hepatitis C virus (HCV) or HIV. Although efficacious drug therapies are available in the developed world, their high financial cost make them effectively unavailable in the developing world where these diseases continue to kill hundreds of thousands each year. Cheap and widely available prophylactic vaccines present the only realistic and cost-effective hope for global control of these epidemics.

Coupling data mining of sequence databases with models and tools from statistical physics, we have developed a computational approach to translate viral sequence databases into empirical fitness landscapes quantifying the replicative capacity of the virus as a function of its amino acid sequence. These landscapes explicitly connect viral genotype to phenotypic fitness to reveal vulnerable immunological targets within the viral proteome that can be exploited to rationally design vaccine immunogens. In this presentation, we will briefly describe our development and validation of these data-driven models for HCV and HIV and their use in the *in silico* design of T-cell vaccines to guide and accelerate experimental vaccine development efforts.

Start-Up Presentation

DIPANJAN PAN

Bioengineering, Beckman Institute for Advanced Science & Technology, Carle Illinois College of Medicine

RESEARCH

Developing personalized medicine through interdisciplinary work from basic science and engineering to clinical applications. He develops defined biomaterials and biosensor platforms to understand the molecular basis of disease for both diagnosis and treatment of medical conditions including cancer, ophthalmologic, and cardiovascular disease.

HONORS

Fellow, American Heart Association, 2017; Fellow, American College of Cardiology, 2017; Nano-Micro Letters Researcher Award, 2016

START-UP COMPANIES

I**nnSight Technology**: developing novel ophthalmic devices to address unmet needs within clinical opthalmology. Based on joint intellectual property with Carle Foundation Hospital.

Kalocyte: Developing novel oxygen therapeutics (synthetic blood).

TALK: A Novel Point-of-Care Biosensor for Real-Time Monitoring of Post-Traumatic and Post-Surgical Eye Injuries to Improve Quality and Reduce Vision Loss

Leaking post-surgical or traumatic ocular wounds are a serious threat to vision and can result in blindness if not urgently identified and treated. In the U.S, 3.4 M cataract, 65 K glaucoma, 50 K corneal, and 71 K traumatic wounds are at risk for leaking each year. There is no objective marker for evaluation of ocular wounds, and the current standard of care is inadequate. In addition, new health care initiatives require hospitals to report quality markers as a benchmark to compare physicians and influence reimbursement.

Post-surgical measurements are a key focus of this policy change, and very few options for post-wound monitoring exist within ophthalmology. Based on a novel nanotechnology platform, OcuCheck is an objective device for eye trauma. The device is the first of its kind to detect leaking wounds to reduce infection rates and enables standardization for wound evaluation. This portable device is designed for use by a technician with accurate and reliable results to reduce health care cost and to improve quality. The technology replaces the use of expensive, immobile slit lamp exams and improves triage of patients and reduces costly transfer to an ophthalmologist.

Research Presentation

PAUL GARRIS

Illinois State University

RESEARCH

Dopamine mechanisms of therapeutic and abused psychostimulants and compensatory responses following degeneration of dopamine neurons. With Pedram Mohseni of Case Western Reserve University, we are developing devices for interfacing with microsensors to measure, process, and regulate brain dopamine signals in real time.

HONORS

Distinguished University Professor

TALK: Neurochemostat for Closed-Loop Regulation of Brain Neurotransmitters

Maintaining brain neurotransmitters at optimal levels is critical to supporting normal behavior and a therapeutic strategy for treating neuropathological states. This talk describes development of a device called a neurochemostat for closed-loop regulation of dopamine, a neurotransmitter involved in the brain functions of motivation, cognition, and motor control. The neurochemostat is interfaced with a brain-implanted microsensor and stimulating electrode and in real time, measures, processes, and controls brain dopamine signals using electrical stimulation.

Proof of principle is demonstrated in an animal model. Potential applications for treating dopamine neuropathologies, such as drug addiction, schizophrenia, and Parkinson's disease, will be discussed.

Research Presentation

PATRICK DEGNAN

Microbiology, Carl R. Woese Institute for Genomic Biology

RESEARCH

Host associated microbes play critical roles in shaping the health of their mammalian hosts. However, among gut microbial gut communities (microbiomes) many of the genetic mechanisms that contribute to these roles are poorly understood. Using diverse and novel experimental and computational techniques, we anticipate uncovering both the genetic mechanisms and the means to improve or manipulate microbiomes.

HONORS

Roy J. Carver Investigator Award; 2014; Bill and Melinda Gates Foundation Grand Challenges Phase I Award, 2016

TALK: CRISPR-Capture: Surveillance Tool for AMR Spread in Microbiomes

In the United States an estimated 2 million infections and 23,000 deaths a year occur from bacteria resistant to antibiotics. As such, tracking antimicrobial resistance (AMR) in hospitals, schools, and agricultural settings are critical for managing the spread of resistance and appropriate deployment of antimicrobial therapies.

However, the single leading mechanism contributing to the spread of AMR genes among bacteria is the transmission of mobile genetic elements (MGEs) such as viruses, plasmids, integrons and conjugative transposons. These elements defeat traditional methods of surveillance because they are modular, highly variable, promiscuous and rare unless they are selected for by the use of antibiotics. Fortunately, bacteria have evolved a surveillance mechanism of their own: the sequence based, CRISPR-cas adaptive immune system.

We are harnessing this CRISPR bacterial system with a novel technology called in vitro CRISPR-capture. In vitro CRISPR-capture will be used as a surveillance tool to track the dissemination, abundance, and transmission of MGEs carrying antibiotic resistance within and between intimately connected environments, agricultural, animal and human ecosystems. I will discuss our current progress of our proof of principle experiments generating and utilizing our novel CRISPR-capture regents.

Start-Up Presentation

ANTHONY BANKS

Physics

EXPERIENCE

Anthony Banks has almost 30 years in academic research with direct hand-on efforts in advanced technology and instrumentation development. His experience includes transferring academic innovations to companies, both large (e.g. Loreal, Medtronic, Reebok and others) and small (MC10, Semprius, CoolEdge Lighting and others) for scalable commercial product manufacturing. He also is co-inventor on several patents, private research consultant and co-founder, VP of Neurolux.

HONORS

Member of the Center of Bio-integrated Electronics (CBIE) at the Simpson Querrey Institute (SQI) for BioNanotechnology

START-UP COMPANY

Neurolux: developing discovery tools for neuroscience.

Successful integration of advanced semiconductor devices with biological systems can yield new tools for neuroscience research, particularly for wireless optogenetic and electrical stimulation. Expanding these type of wireless bio-integrated system provide new device and research opportunities that combine both stimulation with advanced physiological data recording. NeuroLux was recently founded (June 2015) to advance a technology first reported in the John A. Rogers research group, *Science* (Kim 2013), with a goal of introducing low cost, manufacturable wireless electronic systems that combine ultraminiaturized, flexible implantable components with radio frequency power and control systems. In support of that goal, we recently developed a novel optoelectronic system that combines µLED illumination with advanced near-field communication (NFC) components to provide wireless control of neural activity (Shin 2017, *Neuron*).

Our first product, a wireless implantable optogenetic device with complete hardware/software control system, was recently launched (Nov. 2016) and has since been readily adopted worldwide by the scientific community. With the support of a recently awarded NIH Direct to Phase II SBIR award, we are refining our µLED stimulation technology and extending our manufacturing capabilities. *neurolux.org*

TALK: NeuroLux, Innovative Discovery Tools for Medical Research

Providing breakthrough technologies in neuroscience, pharmacology and electrophysiology, with ultra-miniaturized wireless, battery free devices on a versatile hardware platform. The Neurolux technology yields a powerful platform with unique capabilities of critical utility in biological research, drug discovery and clinical care.

Research Presentation

HUIMIN ZHAO

Chemical and Biomolecular Engineering, Carl R. Woese Institute for Genomic Biology

RESEARCH

Developing and applying synthetic biology tools to address society's most daunting challenges in human health and energy, and investigating the fundamental aspects of enzyme catalysis, cell metabolism, gene regulation, and nuclear organization. More specifically, using directed evolution in combination with rational design to create proteins, receptors, biosynthetic pathways, and whole cells with improved or novel functions, followed by detailed biochemical and biophysical characterizations.

HONORS

Steven L. Miller Chair; Charles Thom Award, 2016; Fellow of the American Association for the Advancement of Science (AAAS), 2010; Fellow of the American Institute for Medical and Biological Engineering (AIMBE), 2009

TALK: Programmable DNA-Guided Artificial Restriction Enzymes

Restriction enzymes are essential tools for recombinant DNA technology that have revolutionized modern biological research. However, they have limited sequence specificity and availability. To address these limitations, we recently developed a *Pyrococcus furiosus Argonaute* (PfAgo) based platform for generating artificial restriction enzymes (AREs) capable of recognizing and cleaving DNA sequences at virtually any arbitrary site and generating defined sticky ends of varying length. We demonstrated the utility of AREs in DNA profiling and PCR-based gene cloning. In addition, we are developing AREs-based strategies for rapid assembly of large DNA molecules for synthetic biology applications and direct cloning of large DNA molecules for cancer diagnostics.

Research Presentation

OLGICA MILENKOVIC

Electrical and Computer Engineering, Carl R. Woese Institute for Genomic Biology

RESEARCH

Developing new approaches for studying problems in bioinformatics and bioengineering using coding and information theory. In particular, we investigate fundamental questions pertaining to design methodologies for DNA microarrays with error- and quality-control features and DNA microarrays that utilize compressed sensing principles.

HONORS

Dean's Excellence in Research Award, 2017; Distinguished Lecturer of the Information Theory Society, 2015; NSF Career Award, 2007

TALK: Portable and Random-Access DNA-Based Storage Systems

Despite the many advances in traditional data recording techniques, the surge of Big Data platforms and energy conservation issues have imposed new challenges to the storage community in terms of identifying extremely high volume, non-volatile and durable recording media. To address these challenges, the new paradigm of macromolecular storage was put forward by a number of researchers.

Among all macromolecules used, DNA stands out in so far that it lends itself to implementations of recoding media of outstanding integrity and extremely high storage capacity.

Building upon the rapid growth of biotechnology systems for DNA synthesis and sequencing, we developed and implemented the first portable DNA-based rewritable and random access device. Our system is based on DNA editing, new alignment algorithms and constrained and error-control coding techniques that ensure data reliability, specificity and sensitivity of access, and at the same time, provide exceptionally high data storage capacity. The coding methods used include prefix-synchronized codes, and newly introduced profile codes and mutually uncorrelated codes. As a proof of concept, we encoded in DNA parts of the Wikipedia pages of six universities in the USA and Citizen Kane images, selected specific content blocks and edited portions of the text within various positions in the blocks. We showed that error-free readouts may be achieved even with noisy nanopore MinION readout platforms. (*Scientific Reports*, 2017)

Research Presentation

CATHERINE BLAKE

School of Information Sciences

RESEARCH

Research in health informatics exploring both human and automated methods to synthesize evidence from text. Building on industrial experience as a software developer, formal training in information and computer science and more than a decade of text mining, Dr. Blake's natural language processing techniques successfully identify and summarize claims from full-text articles; predict authorship of movie reviews; and recognize textual entailment from news stories.

HONORS

Faculty Fellow, Lister Hill Center for Biomedical Communications, National Library of Medicine, 2016/17; Faculty Fellowship, Environmental Change Institute 2010/11; John Wiley & Sons Best Paper Award, Journal of the American Society for Information Science and Technology, 2007

TALK: Mining Literature to Support Evidence-Based Practice

Scientific literature has never been more accessible, but the quantity of high quality research far exceeds our human processing capacity. Our goal is to develop automated tools that synthesize information so that the new knowledge can more easily support evidence-based practice.

The key to achieving this goal is to focus on the key findings (or claims) reported in peer-reviewed literature. The Claim Framework (Blake, 2010) characterizes experimental findings into five types of claims – explicit, implicit, correlation, comparison and observation – that have been observed in a range of biomedical research settings. Explicit claims appear most often, but comparisons (Blake and Lucic, 2015) provide a rich source of information such as exactly what was measured when testing a new treatment regime.

In this presentation we introduce the claim framework and show how explicit and comparison claims can unpack where current knowledge agrees and disagrees, and where gaps in science remain. Example summaries from research in breast cancer and diabetes will be used to illustrate how these techniques can better connect discovery and practice.

Research Presentation

JIAN PENG

Computer Science

RESEARCH

Developing computational techniques for processing, integrating and analyzing massive datasets in genomics, systems biology and molecular biology. Includes integrative and network-based approaches for understanding molecular mechanisms of human diseases and accelerating drug development.

HONORS

Microsoft Azure Research Award, 2017/18; PhRMA Foundation Award in Informatics, 2017; Sloan Research Fellowship, 2016

TALK: Using AI to Accelerate Drug Discovery

Computer-aided drug discovery methods have been widely used in the development of therapeutically important small compounds for decades. These traditional approaches are mainly based on the information of known ligands and/or target proteins, which are often not known for many diseases. The recent growth of genomic data and the advances in biotech and artificial intelligence have greatly enhanced our capability on understanding the underlying biological processes of diseases and identifying novel drug targets.

In this talk, I will showcase an example of how artificial intelligence can be used to discover new disease factors and drug targets in Parkinson's Disease. We have developed an algorithm, TransposeNet, which has successfully generated a number of "humanized" synuclein networks from experimental data in a model organism, allowing for testable biological hypotheses to be generated. They linked many parkinsonisms and neurodegenerative disease risk factors to a-syn through specific molecular mechanisms. By identifying connections between druggable targets and gene networks, our approach provides a glimpse of how treatments might one day be targeted to specific genetic lesions. Finally, I will also briefly introduce several other new algorithms for drug target identification, drug sensitivity analysis, and molecular design.

Research Presentation

KAREN WHITE, M.D., PH.D.

Carle Foundation Hospital, Carle Illinois College of Medicine

RESEARCH

Dr. White's medical specialty is in critical care, with a research focus on sepsis identification and severe sepsis and septic shock management. She is a member of the Executive Faculty Committee of the new Carle Illinois College of Medicine.

HONORS

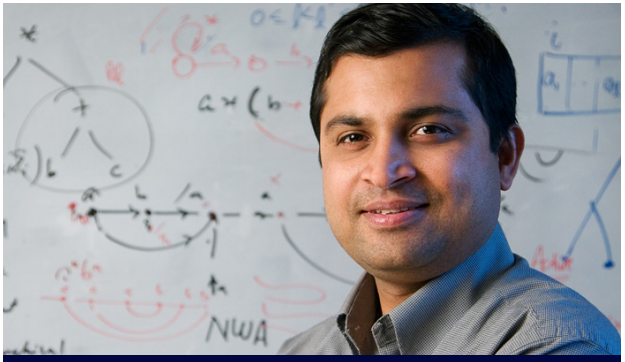
Fellow of the American College of Physicians; Board Certified in Internal Medicine, Critical Care and Neurocritical Care; PhD, The Pennsylvania State University, Chemical Engineering; MD, University of Illinois College of Medicine at Urbana-Champaign;

TALK: Combining Biomarkers with EMR Data to Improve Sepsis Identification

Sepsis is a leading cause of death and is the most expensive condition to treat in U.S hospitals. Despite targeted efforts to automate the earlier detection of sepsis, current techniques rely exclusively on using either standard clinical data or novel biomarker measurements.

Our research delves into the role of biomarker and machine learning techniques to help the Emergency Department physician identify septic patients by gathering biomarkers during the entire hospitalization. We apply machine learning techniques to assess the predictive power of combining multiple biomarker measurements from a single blood sample with electronic medical record data (EMR). Measuring biomarkers as the sepsis is treated should give a picture of severity of disease and resolution of inflammation.

Our studies have shown improvement when combining biomarkers and EMR data compared to using solely EMR data. In a recent study, we showed that a single measurement of six biomarkers yielded the same predictive power as collecting an additional 16 hours of EMR data, suggesting that the biomarkers may play a significant role in diagnosing sepsis earlier. Ultimately, supervised learning using a subset of biomarker and EMR data as features may be capable of detecting sepsis in a diverse patient population and may provide a tool to guide resuscitative efforts for the sickest of the septic patients in the intensive care unit.



Research Presentation

SAURABH SINHA

Computer Science, Carl R. Woese Institute for Genomic Biology

RESEARCH

Exploring computational approaches to problems in molecular biology, in particular gene regulation in metazoan genomes and understanding how sequences involved in gene regulation have evolved, and how such evolutionary dynamics may inform the discovery of novel regulatory sequences.

HONORS

NSF Career Award, 2017; PhRMA Foundation Award in Informatics, 2017

TALK: Building a Knowledge Engine for Genomics

The NIH BD2K Center of Excellence at UIUC and Mayo Clinic is developing advanced analytics and cyberinfrastructure to empower biological scientists seeking to understand their genomic data sets in the context of prior biological knowledge. Our analytical approaches include combining machine learning and statistical techniques with graph mining and data mining tools in novel ways. Cyberinfrastructure challenges arise from our vision of offering the users access to a scalable, easy-to-use, cloud-based platform for performing computer-intensive analytics, obviating heavy investments in hardware, software and human resources.

We also strive to achieve interoperability of this analysis system with the several emerging cloud-based data repositories that are changing the face of genomics. All of our research and development is carried out in the context of impactful driver projects that include individualized medicine for cancer and genetic bases of social behavior. This talk will present a short overview of the Center's efforts towards democratizing genomics analysis.

Research Presentation

CHENGXIANG ZHAI

Computer Science, Carl R. Woese Institute for Genomic Biology

RESEARCH

Developing intelligent information systems (such as intelligent search engines, recommender systems, text analysis engines, and intelligent task assistants) to help people manage and exploit large amounts of data, especially text data. In particular, building such intelligent systems for improving health, medical care, education, and accelerating scientific discovery.

HONORS

Willett Faculty Scholar; HP Innovation Research Award, 2011-2012; ACM Distinguished Scientist, 2009; IBM Faculty Award, 2009

TALK: Medical DataScope: Leveraging Medical Big Data to Optimize Medical Decisions

The availability and rapid growth of data sets in the medical domain (e.g., electronic medical records, online health forums, medical literature, and biomedical knowledge bases) create an unprecedented opportunity for using information retrieval, data mining, and machine learning techniques to turn massive amounts of medical data into actionable knowledge for optimization of medical decisions, leading to improved healthcare quality with reduced cost.

In this talk, I will present the vision of developing an intelligent medical assistant software system (called a medical DataScope) to leverage this opportunity to help optimize medical decisions. Just as a microscope allows us to see things in the "micro world," and a telescope allows us to see things far away, a DataScope would allow us to "see" useful hidden knowledge buried in large amounts of medical data that would otherwise be unknown to us.

As example techniques for building such a medical DataScope, I will present our recent research results on improving medical case retrieval, analyzing electronic medical records for subcategorization of diseases, discovering adverse drug reactions from online health forums, and leveraging biomedical knowledge base to improve cancer patient survival analysis.

Research Presentation

RASHID BASHIR

Bioengineering, Carl R. Woese Institute for Genomic Biology, Carle Illinois College of Medicine

RESEARCH

Integrating biology & medicine with micro & nanotechnology to address problems such as diagnostics, therapeutics, tissue engineering and bio-inspired self-assembly.

HONORS

Fellow, American Association for Advancement of Science, 2012; Fellow, American Institute of Medical and Biological Engineering, 2010; Fellow, Institute of Electrical and Electronics Engineers, 2009

START-UP COMPANY

Prenosis: utilizing microfluidic and electrical sensing technologies to develop "first degree sensing" products - where the output characteristics of the sensor are modulated by intrinsic characteristics of the target entities.
prenosis.com

TALK: Microfluidics and Nanotechnology for Rapid Detection of Biological Entities

Integration of biology, medicine, and fabrication methods at the micro and nano scale offers tremendous opportunities for solving important problems in biology and medicine and to enable a wide range of applications in diagnostics, therapeutics, and tissue engineering. Microfluidics and Lab-on-Chip can be very beneficial to realize practical applications in detection of disease markers, counting of specific cells from whole blood, and for identification of pathogens, at point-of-care. The use of small sample size and electrical methods for sensitive analysis of target entities can result in easy to use, one-time-use assays that can be used at point-of-care.

In this talk, we will present our work on detection of T cells for diagnostics of HIV AIDs for global health, development of a Blood Cell analysis on a chip, electrical detection of multiplexed nucleic acid amplification reactions, and detection of epigenetic markers on DNA at the single molecule level.

Start-Up Presentation

JEAN PAUL ALLAIN

Nuclear, Plasma and Radiological Engineering; Beckman Institute for Advanced Science & Technology

RESEARCH

Designing self-organized nanostructures with directed irradiation synthesis and directed plasma nanosynthesis to enable multi-functional and multi-scale properties at surface and interfaces of dissimilar material systems. Research areas include advanced functional biointerfaces and in-situ, in-operando diagnostics.

HONORS

Dean's Award for Excellence in Research, 2017;
Faculty Entrepreneurial Fellow, 2016;
Fulbright Fellow in Innovation & Technology, 2015;
Professor of Technology Entrepreneurship

START-UP COMPANY

Editekk (Energy Driven Technologies): Surface and interface technologies developed by Editekk provide value-added functionality to a wide variety of materials and products impacting major industries from biomedicine to energy. Modification and functionalization encompass a wide spectrum of applications including: biomedical devices, biofuels, catalysts, tool coatings, engine components, nano electronic and nano photonic devices, membranes, and ceramics. *editekk.com*

TALK: Innovating Bioactive Interfaces for Next-Generation Personalized Medical Implant Technology

The future of next-generation biomedical implant technology is the advent of smart (personalized), nutrient (bioresorbable) and multi-functional biomaterials that are tailored to a patient's physiology. The implant surface is critical in determining both the success of the implant and regeneration of the host tissue.

We have pioneered a low-cost, non-toxic, scalable synthesis technology that can transform materials into "adaptive smart interfaces" tailored to respond uniquely to a pre-defined environment and adapt to its conditions. Directed plasma nanosynthesis (DPNS) is used as an atomic-scale additive nano-manufacturing process to independently modify surface topography and surface chemistry. This results in reduction of 40-50% in fabrication costs and an increase of 200-300% in bone and/or soft tissue regeneration and fixation while preventing infection to the native tissue. The biomedical implant market is expected to reach $60.7B by 2020 mainly driven by innovation of implant bioactive surfaces. Our team has identified key market entry opportunities in the spine implant space. This talk will summarize our latest findings and future opportunities.

Research Presentation

GRAHAM HUESMANN, M.D., PH.D.

Carle Foundation Hospital, Carle Illinois College of Medicine

RESEARCH

Dr. Huesmann's medical specialty is in the intersection between neuronal and brain physiology and epilepsy genesis and progression. He is a member of the inaugural faculty of the new Carle Illinois College of Medicine.

HONORS

Board Certified in Neurology, American Board of Neurology and Psychiatry; PhD, University of Illinois at Urbana-Champaign, Neuroscience; MD, University of Illinois College of Medicine at Urbana-Champaign

TALK: Shaking the Brain Towards Better Health - Magnetic Resonance Elastography (MRE) and Mesial Temporal Sclerosis Epilepsy (MTSE)

MRE is a new technique greatly enhanced by Drs. Sutton and Johnson at the Beckman Institute to allow for measurement of brain tissue. It can be added to any existing MRI scanner for a low cost. An ongoing clinical trial is assessing the structural changes in the mesial structures of patients with MTSE. MTSE is a common and devastating epilepsy leading to seizures that are resistant to medications and to loss of the patient's ability to make new memories (due to damage of the mesial structures like the hippocampus over time) and thus loss of driving, working, child care abilities, and independence. Often these patients are 1) not identified until significant damage is done and 2) not treated for seizures or considered for surgical options until a change can be seen on a traditional MRI.

We have so far found a change not only in the sclerotic side, but also in the side that appears normal on an MRI in these patients. Thus, we may be able to identify these patients much earlier and to identify which is the "bad" side long before current techniques. Early treatment and close follow up of these patients will allow for retention of the patients' productive years and decrease morbidity and mortality. This technique can change the management for these patients worldwide. MRE likely has applications for extra temporal epilepsy as well.

Research Presentation

AMY WAGONER JOHNSON

Mechanical Science and Engineering, Carl R. Woese Institute for Genomic Biology, Carle Illinois College of Medicine

RESEARCH

Designing synthetic bone substitute materials and systems and investigating how cells and tissues interact with or modify their environment, how tissue grows into the substitute and how drug or stem cell delivery can improve bone in-growth.

HONORS

Center for Advanced Study Associate, 2017-2018; Chair of Excellence 2015-2017; Arnold O. Beckman Research Award, 2011;

TALK: Capillary Forces, Scaffolds, and Bone Regeneration

Millions of people undergo bone graft procedures annually in the US to repair bone defects that cannot heal on their own. These defects severely decrease quality of life and are both a personal economic burden to those affected as well as a burden to the health care system. The already considerable demand is growing rapidly as the population ages and life expectancy increases. New approaches are needed that are safe, can be implemented in the near-term, and that could be applied to a range of defect sizes and shapes.

We use a "scaffold-based" approach in which we implant a porous material, a scaffold, into bone defects. Our approach is novel in that we use capillary forces to impregnate scaffolds with cells and molecules that will enhance regeneration in the defect. These scaffolds have multiple length scales of porosity – pores that are microns in size generate capillary forces and pores 100's of microns allow for bone growth into the scaffold, and therefore the defect. Bone regeneration was significantly enhanced, with regeneration deeper into the defect, through the use of capillary forces. The results have important implications in scaffold design and use of this mechanism will help to address the challenging task of repairing large bone defects.

Research Presentation

ZHI-PEI LIANG

Electrical and Computer Engineering, Beckman Institute for Advanced Science & Technology

RESEARCH

Developing methods for optimal acquisition, reconstruction and processing of MR images with application to functional neuroimaging, real-time cardiac imaging, and cancer imaging.

HONORS

Otto Schmitt Award, 2012; Fellow, International Society for Magnetic Resonance in Medicine, 2010; Fellow, Institute of Electrical and Electronics Engineers, 2006; Fellow, American Institute for Medical and Biological Engineering, 2005

TALK: Ultrafast MR Spectroscopic Imaging: A Marriage of Spin Physics and Machine Learning to Enable Label-Free Molecular Imaging

Since its invention in the early 1970s, magnetic resonance imaging (MRI) has revolutionized medicine and biology. However, its applications thus far have been limited primarily to structural imaging and functional imaging. MR spectroscopic imaging (MRSI) has long been recognized as a potentially powerful tool for non-invasive, label-free molecular imaging by exploiting the fact that different molecules have different chemical-shift and J-coupling effects on the MR spectra. However, current MRSI technology, after more than three decades of development, still falls far short of providing adequate spatial resolution, speed, and SNR useful for label-free molecular imaging applications.

The talk will discuss our recent “breakthroughs” in overcoming the long-standing technical barriers of label-free molecular imaging using MRSI. This ultrafast MRSI technology, resulting from many years of research efforts, is based on a new approach to spatiospectral imaging, which includes rapid data acquisition, sparse sampling of (k, t)-space, constrained image reconstruction, and learning-based spectral quantification using spectral basis from quantum mechanical simulations. This technology has achieved an unprecedented combination of resolution, speed and SNR for MRSI. In this talk, I will give a brief overview of this new technology and discuss its potential applications.

Research Presentation

MICHAEL OELZE

Electrical and Computer Engineering, Beckman Institute for Advanced Science & Technology, Carle Illinois College of Medicine

RESEARCH

Super resolution techniques in ultrasonic imaging, development of quantitative ultrasound imaging for improved diagnostics, monitoring of therapy response using ultrasound, FUS-based therapies and high speed communications in vivo using ultrasound.

HONORS

Senior member, IEEE and IEEE Ultrasonics, Ferroelectronics, and Frequency Control; Fellow, American Institute of Ultrasound in Medicine; Fulbright Scholar, 2012-2013

START-UP COMPANY

Avaz Surgical: develops ultrasound-based imaging systems to automatically detect the presence of nerves during surgical interventions of the spine and for guiding nerve blocks.

TALK: Focused Ultrasound (FUS) Therapy: What You Haven't Heard

In recent years focused ultrasound (FUS) therapy has been highlighted because of its ability to treat a plethora of conditions noninvasively. FUS-based therapy had its initiation at the University of Illinois at Urbana-Champaign almost 60 years ago; due to modern advances, this old idea now has new life.

Our research includes the development of techniques to monitor FUS treatment in situ and in real time, novel FUS based approaches to treating tumors and a novel FUS-based approach to treating multiple sclerosis (MS). MS is a prevalent neurological disease among adults worldwide. Disease modifying therapies are only modestly effective for slowing long-term progression of pathological and disability outcomes. Immunomodulatory therapies represent the primary first line approach for managing MS but can have severe side effects. Immunotherapy agents work by reducing the number of circulating white blood cells (lymphocytes) through a number of mechanisms, e.g., inactivating the lymphocytes or sequestering the lymphocytes to the lymph nodes. We hypothesized that using FUS to elevate the temperature of the cervical lymph nodes in rats with EAE, an animal model of MS, would alleviate symptoms of EAE by reducing lymphocyte burden in the CNS. We used FUS to treat rats at the onset of symptoms of EAE and monitored their clinical disability signs in comparison to rats that underwent only a sham treatment. Remittance of symptoms was observed in the FUS-treated rats in higher numbers compared to sham-treated rats. FUS treatment of cervical lymph nodes in rats with EAE resulted in a significant reduction in EAE disability score, which was not observed in sham-treated rats.

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