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### ILLINOIS INSTITUTE OF TECHNOLOGY

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# Message from the Vice Provost for Research

#### **Dear Colleagues and Friends,**

Greetings! I am pleased to provide you with this report on Illinois Tech's research efforts for the 2015 academic year and our goals for 2016 and beyond. Our two-fold goal for research, during the second year of the Many Voices, One Vision–Moving Forward strategic plan, is to increase our research funding to at least \$60 million per year and to enhance significantly the impact and related visibility of our research efforts.

The first goal is easy to measure and provides a strong indicator of year-to-year success. The qualitative metric—enhancing impact and increasing visibility—is more difficult to measure. Despite the measurement challenge, positive indicators of our stronger impact are appearing. We are increasing our involvement in multi-university/ industry research efforts and external forums often serving as the principal investigator or chair for these efforts. The work of our top researchers is featured in news articles and technical publications. The Nayar Prize, although it does not fall neatly under the umbrella of research, nevertheless is igniting both excitement and energy in the attainment of our high impact goals. This is all extremely important as this stature and visibility contribute to a virtuous cycle of "success breeding even greater success" through our increased capability to attract high quality faculty and students.

This report provides a snapshot of our research enterprise at both the institution and the college level. The good news is that more proposals are being submitted and the dollar amount associated with awards is increasing. We just missed our \$250M proposal goal (up considerably from the just under \$200M in 2014). Unfortunately, this surge in proposals hasn't resulted in an increase in the number or value of our new research awards which declined from \$38M in 2014 to \$36M in 2015. While we are not alone in experiencing declines as the federal and state governments reduce their research expenditures, this decline is obviously not helping us achieve our quantitative strategic plan goal of \$60 million. In addition, though our research revenue was slightly up relative to 2014 (\$33 ->34M), our indirect cost recovery, the money used to fund our university infrastructure that supports our research, was down slightly. Obviously we will need to do better in both quantitative and qualitative categories to achieve our university goals. Given our aspirations, our 2016 goals for new proposals and awards are \$300M and \$42M respectively (both ~20% increases from 2015).

Our research enterprise is a critical component of the university's mission and an area where there is much to be done. More of us need to be actively engaged in research efforts--and those of us who currently are need to aim higher. To support this work, the Office of Research is facilitating a variety of new initiatives to assist in the proposal development and submission process. We will be rolling out a new research support system during the upcoming academic year as well as sponsoring focused meetings to connect faculty groups in order to stimulate the development of large interdisciplinary project proposals. In conjunction with the deans and institute directors, we embarked on reviews of our research centers with the goal of finding ways to better support their initiatives. We are also dedicating considerable effort to strengthening relationships with external university partners, such as the Illinois College of Optometry, and with corporate sponsors. Though challenging, increasing our level of contribution to and research funding from companies should enhance our research focus and aid us in our quest to find real world applications for the knowledge and technologies we develop.

Finally, we are working to enhance the recognition for the accomplishments and hard work of our research community. This report is one of many efforts to make more people aware of what is taking place here at Illinois Tech--and which faculty are providing the leadership in research. And in the years ahead, we hope to be recognizing an increasing number of faculty for their efforts.

I wish you all an extremely productive and successful year!

Best regards.

1 Kooman

Dennis Roberson | Vice Provost for Research



### Highlights from the Office of Research

- > The Office of Sponsored Research and Programs (OSRP) recorded \$36,181,071 in awards received in FY15, with facilities and administrative costs awarded of \$5.649.037. These compare favorably with FY14 outcomes, \$38,042,795 and \$6,803,535, respectively.
- > In FY15, Illinois Tech researchers submitted 416 proposals, requesting a total of \$243,530,769. This marks an increase in dollars from FY14, where Illinois Tech researchers submitted 411 proposals and requested a total of \$195.284.139. Since proposals often vield research awards six months after they are submitted, this increase in proposal dollars provides the opportunity for awards growth in the current academic year.
- > The Office of Research (OR) welcomed 38 new faculty members at the New Faculty Orientation. New faculty gained familiarity with the staff and services of the Offices of Sponsored Research, Research Compliance, and Grant and Contract Accounting.
- > OR welcomed **36** students at the Fellowship forum during the Fall 2014 semester. Students were provided with information about the application and evaluation processes associated with prestigious research fellowships, including opportunities such as the NSF Graduate Research Fellowship.
- > OR awarded two \$25,000 multi-disciplinary Educational and Research Initiative Fund grants to faculty. This year's winners were collaborations between Aron Culotta (CS) and Jennifer Cutler (SSB), and between Salim El Rouayheb (ECE), and Dong Jin (CS).
- > OR awarded Starr-Fieldhouse fellowships to two students in 2015. This year's winners were Lu Liu (ECE), advised by Yu Cheng, and Razane Tajeddine (ECE), advised by Salim El Rouayheb.
- > OR continued to stimulate collaborative multi-disciplinary research at Illinois Tech through research forums and small group meetings. The fall 2014 Research Forum highlighted the work of Illinois Tech NSF CAREER Award Winners while the spring 2014 forum brought together Illinois College of Optometry faculty and Illinois Tech faculty interested in factors, such as diabetes, that affect vision.
- > OR held focus groups on cancer research, operations research and UI Labs: Project CITYWORKS in order to discuss potential academic initiatives.

- > OR hosted the 11<sup>th</sup> Annual Research Day at Illinois Tech highlighting research accomplishments of students and faculty. The event included a poster session with 43 student participants and **33** faculty and staff judges. The undergraduate winners were: 1st place: Yusra Sarhan (BME), advised by David Mogul (BME); 2nd place: Ritika Dhawan (BME), advised by Georgia Papavasiliou (BME); and 3rd place: Georgi Hristov (MMAE), advised by David Williams (MMAE). The graduate winners were: 1st place: Martin Detrois (MMAE), advised by Sammy Tin (MMAE); 2nd place: Javid Mahmoudzadeh (MMAE), advised by Kevin Cassel (MMAE); and 3rd place: Qing Li (IFSH), advised by Tong-Jen Fu (IFSH). Following the poster session, Argonne Distinguished Fellow Mike Pellin delivered the Sigma Xi Lecture.
- > OR and the Illinois Tech chapter of Sigma Xi recognized three faculty members and one graduate student for exceptional research accomplishments. This year's Illinois Tech/ Sigma Xi Excellence in Research award winners were: Patrick Corrigan (Psychology), senior faculty; Adam Hock (Chemistry), junior faculty; Liad Wagman (Economics), junior faculty; and Chris Pelliccione (Physics), student, advised by Carlo Segre.
- > ORCPD continued to work to support the Campuswide Safety Working Group (CSWG), which is charged with overseeing safety compliance in all teaching and research labs on Illinois Tech campuses. Voiceovers were also completed for a comprehensive series of online presentations on laboratory safety.
- > ORCPD launched a new service called Fund Searching Services Team or "FSST!" in fall 2014. FSST! offers personalized coaching including "house calls" for faculty members seeking funding for research. The team's new targeted approach is an alternative to bombarding faculty members with irrelevant funding opportunity emails. FSST! developed and distributed a comprehensive new "advice template" of best practices on grant seeking to approximately 40 faculty. The new template is based on best practices gleaned from interviews with successful grant seekers and from the National Organization of Research Development Professionals (NORDP).
- > FSST! also presented **six** workshops and panel discussions for faculty including Fund Searching, Crafting a Strong Research Proposal, Building Research Teams, and other topics. Building Research Teams, a new effort from FSST!, is an ongoing series of panel discussions by faculty and deans offering mentoring on what it takes to build multidisciplinary teams. Presenters included Christine Himes (Dean, Lewis College of Human Sciences), Russell Betts (Dean, College of Science), Carlo Segre (Professor, Physics), and Roya Ayman (Professor, Psychology).

# Overview of Proposals and Awards

2016 Goals: \$300M in Proposals and \$42M in Awards

#### TOTAL NUMBER OF PROPOSALS SUBMITTED



#### TOTAL DOLLAR AMOUNT REQUESTED (IN THOUSANDS)





TOTAL NUMBER OF AWARDS

#### \*American Recovery and Reinvestment Act (ARRA)

## Illinois Tech Research









### Overview of Awards, Revenue, Expenditures, and Recovered Costs

# Proposals and Awards by College: Total FY13-15



TOTAL DOLLARS AWARDED EACH FISCAL YEAR



TOTAL REVENUE BY FISCAL YEAR

DOLLARS REQUESTED



AWARDS AND EXPENDITURES (IN THOUSANDS)



#### ADMINISTRATIVE AND FACILITIES COSTS AWARDED AND RECOVERED (IN THOUSANDS)







ACE: Armour College of Engineering; ARCH: College of Architecture; CoS: College of Science; ID: Institute of Design; LAW: Chicago-Kent College of Law; LCHS: Lewis College of Human Sciences; SAT: School of Applied Technology; SSB: Stuart School of Business

\*American Recovery and Reinvestment Act (ARRA)

\* IIT Research Institute (IITRI)

### LCHS ARCH LAW 10 SSB 4% 1% 1% 1% SAT 6% ACE 51% Cos 35%

#### NUMBER OF PROPOSALS SUBMITTED

#### NUMBER OF AWARDS



## Proposals and Awards by College: Total FY13-15

# Dollars Awarded and Number of Awards by Sponsor Type: Total FY13-FY15



**DOLLARS REQUESTED** 

(IN THOUSANDS)

NUMBER OF PROPOSALS SUBMITTED



DOLLAR AMOUNT AWARDED BY SPONSOR TYPE, TOTAL FY-13-15



DOLLARS AWARDED (IN THOUSANDS)



NUMBER OF AWARDS



DOLLAR AMOUNTS AWARDED BY SPONSOR TYPE FY-13-15 (IN THOUSANDS)



ACE: Armour College of Engineering; ARCH: College of Architecture; CoS: College of Science; ID: Institute of Design; LAW: Chicago-Kent College of Law; LCHS: Lewis College of Human Sciences; SAT: School of Applied Technology; SSB: Stuart School of Business NUMBER OF AWARDS BY SPONSOR TYPE, TOTAL FY-13-15



NUMBER OF AWARDS BY SPONSOR TYPE FY-13-15



### Breakdown of Federal Funding Sources

#### **TOP FEDERAL FUNDING SOURCES**

- > National Institute of Health
- > Food and Drug Administration
- > Department of Energy
- > National Science Foundation

#### BREAKDOWN OF FEDERAL FUNDING SOURCES, FY15

Some U.S. Department of Defense funds were awarded through:

- > U.S. Air Force Office of Sponsored Research
- **)** U.S. Navy
- > Office of Naval Research
- **)** U.S. Army
- > U.S. Army Research Office

Some U.S. Department of Energy funds were awarded through:

- > Argonne National Lab
- > Fermilab
- > National Energy Technology Laboratory
- > National Nuclear Security Administration
- > Los Alamos National Lab

Some National Institutes of Health funds were awarded through:

- > National Cancer Institute
- > National Institute of Biomedical Imaging and Bioengineering

Some other funds were awarded through:

- > U.S. Department of State
- > National Institute of Mental Health
- > U.S. Environmental Protection Agency
- > National Security Agency
- > National Institute of Justice



DOE: Department of Energy; NSF: National Science Foundation; NIH: National Institutes of Health; FDA: Food and Drug Administration; DOD: Department of Defense; SBA: Small Business Administration; USDA: United States Department of Agriculture; Ed: Department of Education; FAA: Federal Aviation Administration; NASA: National Aeronautics and Space Administration

## Illinois Tech's Top Researchers

PRINCIPAL	PRINCIPAL
INVESTIGATORS	INVESTIGATORS
WITH RESEARCH	WITH AWARDS
REVENUE EXCEEDING	TOTALING MORE THAN
\$1,000,000 IN FY15	\$1,000,000 IN FY15
David Baker	Robert Brackett
Robert Brackett	David Baker
Patrick Corrigan	Britt Burton-Freeman
Tom Irving	Tom Irving
Regnal Jones	Regnal Jones
Carlo Segre	George Langlois
Mohammad	Mohammad
Shahidehpour	Shahidehpour
Miles Wernick	Miles Wernick
PRINCIPAL	PRINCIPAL
INVESTIGATORS WITH	INVESTIGATORS
RESEARCH REVENUE	WITH AWARDS
BETWEEN \$500,000-	TOTALING \$500,000-
\$1,000,000 IN FY15	\$1,000,000 IN FY15
Weslynne Ashton	Patrick Corrigan
Ali Cinar	Adam Hock
Alex Flueck	Zhiling Lan
George Langlois	Alvin Lee
Boris Pervan	loan Raicu
Vijay Ramani	Vijay Ramani
Dennis Roberson	Carlo Segre
Leon Shaw	Brent Stephens
Jay Shieber Jeffrey Terry	Yagmur Torun

#### PRINCIPAL

INVESTIGATORS WITH COMBINED AWARDS TOTALING MORE THAN \$2,000,000 FOR FY-13-15

#### **David Baker**

Robert Brackett Ali Cinar Patrick Corrigan Alex Flueck Tom Irving Regnal Jones Boris Pervan Vijay Ramani Carlo Segre Miles Wernick

PRINCIPAL INVESTIGATORS WITH COMBINED AWARDS OF \$1,000,000- \$2,000,000 FOR FY13-15

#### Shlomo Argamon

**Weslynne Ashton Eric Brey Britt Burton-Freeman Hyun-Soon Chong** Adam Hock **Zhiling Lan Francis Lane George Langlois Alvin Lee Dennis Roberson** Mohammad Shahidehpour **Leon Shaw Jeffrey Terry Yagmur Torun Philip Troyk Chris White** 

PRINCIPAL INVESTIGATORS WITH MORE THAN FIVE AWARDS IN FY15

#### **Britt Burton-Freeman**

Adam Hock Zhiling Lan Alvin Lee Ioan Raicu Carlo Segre Mohammad Shahidehpour

Leon Shaw

INVESTIGATORS INVOLVED IN (CO-PI ) OR PI OF MORE THAN TWENTY AWARDS FOR FY13-15

#### Eric Brey

Britt Burton-Freeman Alvin Lee

Boris Pervan

Vijay Ramani

Carlo Segre Jeffrey Terry

### NSF CAREER Award Winners

#### RECENT ILLINOIS TECH NSF CAREER AWARD RECIPIENTS

#### Mustafa Bilgic

Assistant Professor of Computer Science

Active Learning through Rich and Transparent Interactions

#### **Seebany Datta-Barua**

Assistant Professor of Mechanical, Materials, and Aerospace Engineering

Coherent Structures in Ionospheric-Thermospheric Flows

#### Yu Cheng

Associate Professor of Electrical and Computer Engineering

Exploring the Underexplored: A Fundamental Study of Optimal Resource Allocation and Low-Complexity Algorithms in Multi-Radio Multi-Channel Wireless Networks

#### Ioan Raicu

Assistant Professor of Computer Science

Avoiding Achilles' Heel in Exascale Computing with Distributed File Systems

#### Vijay Ramani

Associate Professor of Chemical and Biological Engineering

Multi-Functional Materials for Electrochemical Energy Conversion

#### **Shangping Ren**

Associate Professor of Computer Science

Behavior-Based Coordination Model and Programming Techniques for Open Distributed and Real-Time Embedded Computing

#### NSF CAREER AWARD WINNERS AMONG AITU SCHOOLS

Association of Independent Technological Universities (AITU) is an organization of leading private United States technological universities and colleges.

UNIVERSITY	2011	2012	2013	2014	2015	TOTAL
Massachusetts Institute of Technology	12	4	9	13	5	43
Carnegie Mellon University	8	12	6	6	3	35
Rensselaer Polytechnic Institute	3	5	6	4	0	18
Drexel University	2	5	5	3	1	16
California Institute of Technology	3	4	4	2	2	15
Illinois Institute of Technology	4	2	0	2	0	8
Worcester Polytechnic Institute	1	5	1	0	0	7
Case Western Reserve University	1	2	3	0	1	7
Stevens Institute of Technology	2	1	0	3	0	6
Clarkson University	1	0	1	1	0	3
Polytechnic Institute of NY	1	2	0	0	0	3
Embry-Riddle Aeronautical University	0	1	1	1	0	3
Rochester Institute of Technology	0	0	0	2	1	3
Franklin W. Olin College of Engineering	0	0	0	0	0	0
Harvey Mudd College	0	0	0	0	0	0
Lawrence Technological University	0	0	0	0	0	0
The Cooper Union for the Advancement of Science and Art	0	0	0	0	0	0
Keck Graduate Institute	0	0	0	0	0	0
Kettering University	0	0	0	0	0	0
Milwaukee School of Engineering	0	0	0	0	0	0
Rose-Hulman Institute of Technology	0	0	0	0	0	0
Webb Institute	0	0	0	0	0	0

http://nsf.gov/awardsearch/advancedSearch.jsp (Awarded During Calendar Year)

## Educational and Research Initiative Fund (ERIF) Winners

ERIF provides seed funding for high risk or innovative research and education programs at the pre-competitive stage. Funded projects are multi-disciplinary or interdisciplinary in scope and must show the potential for external funding.

#### 2015

**Aron Culotta** and **Jennifer Cutler** Tracking perception dynamics in online social networks

Salim El Rouayheb and Dong Jin Faster Wireless Data Rates via Caching on Smart Devices: Theoretical Analysis & Implementation

#### 2014

Kenneth Tichauer and Jialing Xiang Mapping Molecular Heterogenityin Tumors for Advanced Personalized Cancer Therapy

#### David Minh, Britt Burton-Freeman, and Indika Edirisinghe

Elucidating the Mechanism of Anthocyanin-Induced Insulin Sensitization

#### 2013

#### Eric Houston and Boris Glavic

An Interdisciplinary Approach for Assessing Treatment Motivation Among Patients Undergoing Antiretroviral Therapy: Integrating Multidimensional Scaling with Data Provenance Techniques

#### Matthew Spenko and Donald Chmielewski

Robotic Enhanced Urban Farming

#### Cindy Menches and Scott Morris

Affective Reactions to Construction Contract Framing

#### 2012

#### Arjun Chakravarti and Weslynne Ashton

Agent-Based Models as a Platform for Interdisciplinary Research of Complex Social and Business Systems

#### Georgia Papavasiliou and Fouad Teymour

Feasibility of Using Mixture of High MW PEG and Crosslinked PEG Nanoparticles for Sustained Delivery of Phosphate to the Intestinal Mucosa

#### 2011

#### **Nancy Karuri**

Surface Modifications for Promoting Tissue Repair

#### Mehdi Modares

Structural Health Monitoring and Damage Detection of Existing Structures with Unknown Input and Limited Responses

#### 2010

#### **Mahesh Krishnamurthy**

Real-Time Electromagnetic Modeling and Analysis Technique for Electric Machines

#### Zongzhi Li

Multicommodity Flows and Algorithmic Graph Theory in Sustainable Transportation Decision Making

#### Shawn Shadden

Identifying Key Transport Mechanisms in the Formation of Thrombi

#### 2009

#### Sandra Bishnoi

Using Daphnia Magna and Surface Enhanced Raman Scattering Imaging (SERSI) to Explore the Ecotocity of Metal Nanoparticles

#### **Georgia Papavasiliou**

Quantitative Study of the Effects of PEG Substrate Physical Properties and Degradation Kinetics on Fibroblast Cell Migration

#### Jia Wang

Analysis and Optimization of Sequential Circuits Under Process Variations

#### Imam Samil Yetik

Registration of Histiology to Invivo Multispectral MR Images for Prostate Cancer Localization

### Illinois Tech-Sigma Xi Excellence in Research Award Winners

The Office of the Provost, the Office of Research, and the Illinois Tech Chapter of Sigma Xi sponsor the Illinois Tech/Sigma Xi Awards for Excellence in University Research to recognize exemplary accomplishments in research, scholarship, and creative activity by Illinois Tech faculty.

### 2015

SENIOR FACULTY Patrick Corrigan Psychology

JUNIOR FACULTY Adam Hock Chemistry

JUNIOR FACULTY Liad Wagman

### Economics

#### 2014

SENIOR FACULTY Ali Cinar Chemical and Biological Engineering

SENIOR FACULTY Carlo Segre

Physics

JUNIOR FACULTY Kathiravan

#### Krishnamurthy Institute for Food

Safety and Health

#### 2013

SENIOR FACULTY Christopher White Physics

JUNIOR FACULTY

**Yu Cheng** Electrical and Computer Engineering

### 2012 SENIOR FACULTY Boris Pervan Mechanical, Materials, and Aerospace Engineering

JUNIOR FACULTY **Kui Ren** Electrical and Computer Engineering

### 2011

SENIOR FACULTY **Jinqiao Duan** Applied Mathematics

JUNIOR FACULTY **Zongzhi Li** Civil, Architectural, and

Environmental Engineering

#### 2010

SENIOR FACULTY Yongyi Yang Electrical and Computer Engineering

JUNIOR FACULTY **Eric Brey** Biomedical Engineering

#### 2009

SENIOR FACULTY Xian-He Sun Computer Science

JUNIOR FACULTY Xiaoping Qian Mechanical, Materials, and Aerospace Engineering 2008

#### SENIOR FACULTY **Miles Wernick** Electrical and Computer Engineering

JUNIOR FACULTY Shangping Ren Computer Science

#### 2007

SENIOR FACULTY **Tom Irving** Biology

JUNIOR FACULTY Konstantinos Arfanakis Biomedical Engineering

#### 2006

SENIOR FACULTY **David Williams** Mechanical, Materials, and Aerospace Engineering

JUNIOR FACULTY Mark Anastasio Biomedical Engineering

## 2014-2015 Research Groups

**RESEARCH ACADEMY RESEARCH** C Ali Cinar **Matthew Ba Patrick Corrigan Keith Bowm Tom Irving David Gidal Philip Nash Joel Goldha Boris Pervan** Nancy Karu **Ganesh Raman\* Glenn Krell Shangping Ren** Norm Lede **Dennis Roberson, Chair Eun-Jeong Carlo Segre** Shuwang Li **Xian-He Sun Vedran Mim Miles Wernick David Mogu Chris White Joseph Org David Williams Krishna Pag** Yongyi Yang **Domenica** Nancy Ptak Ganesh Rar **Dennis Rob Stan Rueck Mazin Safar Matthew Sh John Shen Charles Uth** Peng-Jun V **Rong Wang** Wei Zhang \*Ex-Officio Member

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INSTITUTIONAL REVIEW BOARD Patrick Corrigan, Chair Royce Cunningham Libby Hemphill Elisabeth Hildt Eric Houston Patrick Ireland Glenn Krell\* Jon Larson Noah McClain Anita Opdycke

CAMPUSWIDE SAFETY WORKING GROUP Cindy Chaffee, Chair Matt Cusack Todd Diel Andy Howard Oscar Johnson Brad Katz Glenn Krell John Kriegshauser Tim Morrison Sheldon Mostovoy Zabel Panosyan Charles Uth

### **Research Institutes**

#### **IIT RESEARCH INSTITUTE (IITRI)**

IITRI is Illinois Tech's not-for-profit contract research affiliate. With a focus on biomedical research, IITRI's staff of approximately 100 scientists and technicians conducts programs for both government and commercial sponsors. Specific areas of expertise include preclinical toxicology, carcinogenesis and cancer prevention, inhalation technology, molecular biology, analytical chemistry, and biodefense.

#### INSTITUTE FOR FOOD SAFETY

**AND HEALTH** IFSH is a world-class research institute that produces knowledge-based outcomes in the areas of food safety, food defense, and nutrition for stakeholders in government, industry, and academia. IFSH builds on and expands the vital work of the National Center for Food Safety and Technology (NCFST), a unique research consortium of Illinois Institute of Technology, the U.S. Food and Drug Administration (FDA), and the food industry. For more than 20 years, the center has provided a collaborative environment where scientists from industry, academia, and government pool their scientific expertise and institutional perspectives to ensure the

production of safe, wholesome foods. IFSH has four operating centers: NCFST, Center for Nutrition Research, Center for Processing Innovation, and Center for Specialty Programs.

### PRITZKER INSTITUTE OF BIOMEDICAL SCIENCE AND

**ENGINEERING** The Pritzker Institute is an umbrella organization that enhances the biomedical science and engineering research activities on the Illinois Tech campus. The Medical Imaging Research Center, the Center for Integrative Neuroscience and Neuroengineering Research, the Engineering Center for Diabetes Research and Education. the Center for the Molecular Study of Condensed Soft Matter, and the Biophysics Collaborative Access Team operate under the auspices of the Institute. Each of the centers has a director and is described elsewhere in this report. The Pritzker Institute develops and coordinates relationships and programs with traditional science and engineering departments within Illinois Tech, as well as institutions outside the university, including Argonne National Laboratory, Rush Presbyterian Medical Center, and the University of Chicago.

## Research Centers

### THE CENTER FOR ACCELERATOR AND PARTICLE PHYSICS

(CAPP) CAPP provides a locus for interdisciplinary activities at Illinois Tech aimed at the continued development of research in elementary particle physics, development of new particle- accelerator technologies, and education and outreach to educational institutions and to the wider business, philanthropic, and general public sectors. It serves as a base to coordinate the activities of a group of Illinois Tech faculty, graduate students, and staff from various departments currently involved in a number of research programs, and will promote substantial increases in such involvement through a close working relationship with other universities in the region and with Fermilab and Argonne National Laboratory.

#### THE CENTER FOR COMPLEX SYSTEMS AND DYNAMICS (CCSD)

CCSD provides an interdisciplinary collaborative environment for fundamental and applied research for understanding and mathematically describing complex systems; developing mathematical and computational techniques for simulating, analyzing, and modifying their behavior; and applying these methods to various complex systems of national interest. Current research areas include nonlinear and stochastic phenomena in complex systems; multiagent systems; complex networks and adaptive systems; natural and industrial ecologies; dynamics of multiphase systems; fluid turbulence; molecular-level modeling of physical systems; brain electrophysiology and computational neuroscience; and transportation systems.

WANGER INSTITUTE FOR

SUSTAINABLE ENERGY RESEARCH

(WISER) WISER's mission is to

continue to improve the quality of

life and positively impact society

resources and the environment

of this mission will reduce our

for future generations. Fulfillment

dependence on fossil fuels and, at

affordable sources of clean energy

and water. WISER cultivates close

on development of energy-related

interdisciplinary educational and

research initiatives and proposals.

throughout Illinois Tech, spanning

engineering, design, architecture,

and law. WISER plans to further

enhance research and educational

State of Illinois, industry, national

laboratories, and other universities.

The goal of the institute is to play

a leading role in identifying future

national and international energy

policy and sustainability initiatives.

research directions for shaping

partnerships with the City of Chicago,

business, psychology, the sciences,

more than 60 faculty members from

Current WISER activities involve

collaboration among numerous

the same time, provide sufficient and

programs at Illinois Tech with a focus

while preserving our natural

#### THE CENTER FOR ELECTROCHEMICAL SCIENCE AND ENGINEERING The center

conducts basic and applied research primarily in fuel cells and batteries, while preparing students for careers in advanced energy technology.

### THE CENTER OF EXCELLENCE IN POLYMER SCIENCE AND

**ENGINEERING** Established in 1990, the center is home to interdisciplinary research and education that advances polymer science and engineering. Research is conducted on synthesis, rheology, characterization, and processing of polymers.

#### THE CENTER FOR FINANCIAL

**INNOVATION** Financial innovation has been vigorously debated since the financial crisis of 2008. The Center for Financial Innovation (CFI) takes a comprehensive and objective look at the history of financial innovation, providing a central location for scholars, practitioners, media, and the general public to explore the many innovations that serve as the foundation for our global financial system. The Center provides data, video interviews, and an Encyclopedia of Financial Innovation via its website. Formerly named the Center for Financial Markets, and established in 1998 as the Center for Law and Financial Markets, the CFI has evolved from the vision of its first director, John A. (Jack) Wing. A financial and educational innovator, Wing served as chairman of Chicago Corp and ABN AMRO Inc.--and was a trustee of Illinois Tech.

#### THE CENTER FOR INTEGRATIVE NEUROSCIENCE AND NEUROENGINEERING RESEARCH

(CINNR) CINNR's mission is to foster collaborative research in systems and behavioral neuroscience at the University of Chicago, the Rehabilitation Institute of Chicago and other Chicago-area institutions and in neural engineering at Illinois Tech. Work in the center ranges from basic science to clinical efforts and emphasizes interdisciplinary approaches to understanding the complex behavior of the nervous system.

### THE CENTER FOR THE MOLECULAR STUDY OF CONDENSED SOFT

**MATTER** Dedicated to the research of soft matter, both biological and synthetic, this multidisciplinary center has substantial expertise. The center has substantial expertise in cell membranes, collagen, ECM, peptide mimetics, entangled polymers, networks, and the cytoskeleton. Particular emphasis is paid to establishing molecular structure/ property/function relationships. The center houses faculty from biology, engineering, and physics, and is a member of the Pritzker Institute of Biomedical Science and Engineering. Research relies equally on experimental, computational, and theoretical components, including neutron diffraction; X-ray diffraction and scattering; atomic force microscopy; Forced Rayliegh Scattering; micro- and bulk rheology; molecular dynamics simulations; and stochastic and statistical mechanical modeling.

#### THE CENTER FOR NUTRITION RESEARCH The center support

**RESEARCH** The center supports the work of the Clinical Nutrition Research Center, which conducts human nutrition and clinical research to characterize and describe the biological activity of foods and food components in a variety of study areas including nutrient/phytonutrient properties and bioavailability and metabolism, obesity and satiety; and diabetes and cardiovascular disease risk reduction. The unit also manages projects related to the Institute for Food Safety and Health's (IFSH) nutrition research arm.

#### THE CENTER FOR PROCESSING INNOVATION The center provide

**INNOVATION** The center provides expanded food safety, process control, evaluation of novel processing technologies and process validation capabilities for applied research through IFSH's GMP processing area, kitchen and pilot plant; BSL-2 processing innovation laboratory; and the newly commissioned BSL-3 laboratory and biocontainment pilot plant. The unit also administers education and training services, and other targeted commercial projects. The center is equipped with various processing equipment including high pressure processing, retorts and a fresh produce processing line.

THE CENTER FOR SPECIALTY PROGRAMS The center administers key specialized programs, including customized laboratory proficiency testing services that support the U.S. Food and Drug Administration, U.S. Department of Agriculture, state government laboratories, and the Food Emergency Response Network. The center also conducts research on specialty projects involving select agents.

### THE CENTER FOR STRATEGIC COMPETITIVENESS (CSC) The

Center for Strategic Competitiveness develops global partnerships to enhance innovation and creativity, and is the foundation for Illinois Tech's Stuart School of Business strategically competitive curriculum. The Center's mission is to develop strategic competitiveness into an approach to business that will enhance the ability of individuals, organizations, and governmental units to be proactive and innovative in addressing global market challenges in the next economy. In 2014, the Center for Sustainable Enterprise became part of the Center for Strategic Competitiveness, creating opportunities to implement practical and equitable business strategies that advance ecological sustainability, while fostering our current and future economic viability.

### THE CENTER FOR THE STUDY OF ETHICS IN THE PROFESSIONS

(CSEP) Established in 1976, the Ethics Center's mission is to educate students as responsible professionals, to reflect on the wider implications of scientific progress, and to contribute to the shaping of technology in accordance with fundamental human values. Its research program is in ethics in the life sciences and in ethical and societal issues of emerging technologies, with a particular focus on philosophical and ethical aspects of neuroscience. The Ethics Center is committed to multi-disciplinary and multi-institutional research, to projects that combine empirical

investigation with conceptual analysis, and to projects that introduce and propagate innovations in teaching. Furthermore, it houses a worldwide unique collection of ethics codes and a large collection of ethics education materials.

#### THE CENTER FOR SYNCHROTRON RADIATION RESEARCH AND INSTRUMENTATION The center

promotes the application of the tools and techniques of synchrotron radiation to science and engineering research, with a particular focus on developing and operating experimental beam line facilities to serve the needs of various collaborative access teams at the Advanced Photon Source at Argonne National Laboratory.

#### THE CENTER FOR WORK ZONE SAFETY AND MOBILITY (CWZSM)

CWZSM works towards providing long-term solutions to highway work zone safety and mobility problems, by building a consortium of major work zone stakeholders, including transportation agencies, road contractors, the trucking industry, and the insurance industry. By working together through the consortium, the stakeholders can combine their resources and knowledge, and work towards preventing the 50,000 work zone injuries and 1,000 fatalities that occur every year. The initiatives of the center focus on (1) developing highway work zone safety audit guidelines by addressing the concerns and interests of all stakeholders; (2) discovering/ developing/transferring new technologies and measures for improving work zone safety, and minimizing the negative impacts on private industries and the national economy; and (3) providing work zone safety training and education to the transportation community and the public.

### THE ELECTRIC POWER AND POWER ELECTRONIC CENTER

**(EPPEC)** Illinois Tech has long maintained high-quality education and research programs in electric power and energy systems. The mission of EPPEC is to make significant educational, research, and practical contributions to the fields of electric power, power electronics, electric machines, motor drives, and vehicular power systems. The tasks of the center include the sponsorship of technical studies, which will enhance the role of university faculty, manufacturers, vendors, and consumers in power engineering research and education. The center works with centers and departments across Illinois Tech, other institutions, government agencies, and industry to sponsor research projects, short courses, conferences, and seminars.

#### THE ENGINEERING CENTER FOR DIABETES RESEARCH AND EDUCATION (ECDRE) ECDRE's

objective is to use engineering and scientific techniques to develop treatment modalities for diabetes and its many complications. ECDRE is the first center in the U.S. to focus on diabetes treatment. Illinois Tech faculty members, in collaboration with investigators and clinicians at the University of Chicago and Argonne National Laboratory, are working on a variety of diabetesrelated research projects. ECDRE is a component of the Pritzker Institute of Biomedical Science and Engineering, which is developing a biomedical research focus at Illinois Tech.

#### THE FLUID DYNAMICS RESEARCH CENTER (FDRC)

The center consists of six faculty engaged in experimental, computational, and analytical studies of fluid flow and its control. The center has numerous research-quality experimental facilities including highand low-Mach number wind tunnels, jet facilities, water channels, anechoic room, and an axial flow compressor. Extensive computational resources are available for numerical flow simulations. Areas of focus include active flow control for aerospace applications, aeroacoustics, contaminant dispersion predictions, and vortex-surface interactions.

#### ILLINOIS INSTITUTE OF TECHNOLOGY ARCHITECTURE CHICAGO RESEARCH CENTER (IITAC-RESEARCH CENTER) The

keynote of the IITAC-Research Center is "Rethinking Metropolis," the architecture of the multiple. competing entities defining urban life in the new millennium. Urban migrations and the proliferation of information technologies have rendered obsolete the logistical premises and architectural values of the traditional city. We can no longer view architecture as a singular enterprise of making buildings and it is time for a radical critique of our approaches. The task of rethinking our habitats and landscapes in a fundamental way entails a multifaceted and interdisciplinary approach. It will draw upon the cultural, social, economic, and biological sciences, but it will also demand a particular talent and sensitivity to be cultivated in the architect who is ethically charged with environmental interventions. Richard Neutra some years ago opened a book with the somber note that "Nature has too long been outraged by design of nose rings, corsets, and foul-aired subways." Today this observation has become ever more relevant because the problems associated with the metropolis have grown even more acute. We have choices to make as a profession. And if the 21st century is to succeed in improving living conditions for the world's populations, it will be because we have adopted the tools at our disposal and energetically stepped forth with a dynamic vision. The purpose of the IITAC-Research Center is to promote and promulgate invention - to proffer a new vision.

#### THE INTERNATIONAL CENTER FOR SENSOR SCIENCE AND ENGINEERING (ICSSE) The

mission of the Center is to fosteris also home to a spin-off researchcommunications within the scientificeffort in "predictive policing," inand engineering community aboutwhich concepts from medicalsensors and exchange experiencesimage analysis are being applied towith academia, industry and researchpredict crime, in cooperation withlabs through support of scientist,the Chicago Police Department.engineer, student and faculty researchand exchanges and to provide an

interdisciplinary environment for broader areas of sensor research. The ICSSE at Illinois Tech performs basic and applied research in developing chemical and biological sensing systems with novel materials and unique sensing platforms. The center provides the state-of-the-art facilities and the expertise in sensor research. The research outcome will benefit society and improve the quality of life through a cleaner environment, more efficient energy usage, earlier diagnosis and effective treatment of diseases, and safer food.

#### THE MEDICAL IMAGING RESEARCH CENTER (MIRC) The Medical

Imaging Research Center (MIRC), affiliated with the Pritzker Institute of Biomedical Science and Engineering, is an interdisciplinary research team focused on technological advances in the field of medical imaging. MIRC, which is housed in Illinois Tech's University Technology Park, is home to six faculty members from the departments of Electrical and Computer Engineering (ECE) and Biomedical Engineering (BME), as well as their student research assistants, research associates. and labs. MIRC contains two experimental laboratories, the Advanced X-ray Imaging Laboratory (AXIL) and the Molecular Imaging Laboratory (MIL), which support research into new forms of medical imaging and their applications. In addition to its role as a research team, MIRC acts to foster interdisciplinary research cooperation and educational initiatives at Illinois Tech in medical imaging, including degree programs in the ECE and BME departments. MIRC research spans a wide array of methodologies such as MRI, CT, SPECT, and PET, and conventional and phase-contrast x-ray, and numerous applications in medicine, including heart disease. cancer, and Alzheimer's disease. MIRC is also home to a spin-off research effort in "predictive policing," in which concepts from medical image analysis are being applied to predict crime, in cooperation with the Chicago Police Department.

#### THE NATIONAL CENTER FOR FOOD SAFETY AND TECHNOLOGY

NCFST, IFSH's cornerstone principal operating center, continues to operate under its longtime cooperative agreement between Illinois Tech and the U.S. Food and Drug Administration, focusing on design and performance of a variety of collaborative and cooperative research projects across several focus areas, including microbiology; chemical constituents; allergens; food processing, packaging; methods validation; and nutrition.

#### ROBERT W. GALVIN CENTER FOR ELECTRICITY INNOVATION The

**ELECTRICITY INNOVATION** The mission of the Galvin Center is to pursue groundbreaking work in the generation, transmission, distribution, management, and consumption of electricity. As a part of Illinois Tech WISER, the Galvin Center brings together faculty, students, researchers, industry, government, innovators, and entrepreneurs to collaborate to improve the reliability, security, and efficiency of the electric grid and overcome obstacles to the national adoption and implementation of the smart grid.

#### THERMAL PROCESSING TECHNOLOGY CENTER (TPTC)

Through TPTC, faculty and students perform high-quality basic and applied research in thermal processing technology to support the needs of the materials processing, primary metals and manufacturing industry. In addition, the center provides training and education to enhance the industries' human resource operations. Of special note are the innovative, crosscutting technological solutions to industrial materials processing problems that are being developed by multidisciplinary research teams.

#### WIRELESS NETWORK AND COMMUNICATIONS RESEARCH CENTER (WINCOM) Founded in

2006, WiNCom is an initiative of the computer science and electrical and computer engineering departments. Motivated by the continuing growth in the use of the radio frequency

spectrum, and the desire to increase RF spectrum utilization and efficiency, WiNCom fuses the creative talents of faculty and students from across the university. WiNCom's signature achievement is the 2007 establishment and ongoing operation of the Illinois Tech Spectrum Observatory, which is creating a continuous record of RF spectrum utilization in Chicago. Research programs include RF spectrum measurements; RF measurement data storage and analysis techniques; cognitive radio; communication system modeling; RF coexistence; and RF interference modeling and mitigation. Application areas are licensed and unlicensed spectrum, public safety, smart grid, and spectrum sharing. The center has generated numerous technology transfers and spinoffs, including a commercial RF spectrum observatory network. Center researchers have ongoing engagements with the FCC and other government entities including the U.S. Commerce Department Spectrum Management Advisory Committee.

## Service, Education, and Outreach Centers

#### THE CENTER FOR RESEARCH

**AND SERVICE** The center offers professional consulting services through the Department of Psychology at Illinois Tech. The center supports its clients through research-based solutions that improve individual, team, and organizational performance.

#### THE CENTER FOR SUSTAINABLE

**ENTERPRISE** The center's goal is to identify, develop, communicate, and help implement practical and equitable business strategies that advance the ecological sustainability of the greater Chicago area, while fostering our current and future economic viability.

#### ENERGY/ENVIRONMENT/

**ECONOMICS (E3)** E3 is an academic program of research and coursework for students in engineering. The research program encompasses areas of specialization that relate to energy, sustainable development, industrial ecology, and environmental design.

#### **GRAINGER POWER ENGINEERING LABORATORY (GPEL)** GPEL focuses on studies related to electric-powergeneration transmission, distribution, operation, and controls. GPEL houses several graduate and undergraduate laboratories. Annual research support of more than \$400,000 is provided by federal and private agencies.

#### THE INSTITUTE FOR SCIENCE. LAW & TECHNOLOGY (ISLAT)

The Institute for Science, Law and Technology provides a forum to produce and disseminate knowledge on the social and legal implications of emerging technologies. As part of its mission, the institute sponsors long-term, multidisciplinary research, public conferences, judicial training, symposia for journalists, and other programs. Public programming, scholarship, research, and student educational opportunities focus on biotechnology, genetics, nanotechnology, environmental science, social networks, mobile apps and intellectual property. In addition, institute staff and faculty draft laws and regulations, and develop other programs that guide public policy decisions.

#### THE INVENTION CENTER The

center, which helps students and faculty develop a studio approach to engineering, is project-oriented, creativity-driven and encompasses all the stages of invention, including idea generation and development; prototype development and proof-of- concept; and the patent process and commercialization.

### Faculty Research Highlights

#### **Patrick Corrigan**

**TITLE:** Community Based Participatory Research (CBPR) for African Americans with Serious Mental Illness

**INVESTIGATORS:** Patrick Corrigan (PI), Lindsay Sheehan, and Sonya Ballentine

FUNDING AGENCY: Patient Centered Outcomes Research Institute

This two-year community-based participatory research (CBPR) project addresses disparities in integrated health care for African Americans with serious mental illness. During phase one of the project, an advisory board composed of African Americans with serious mental illness, health providers and researchers is meeting weekly to develop a CBPR training curriculum. During the second phase, the advisory board will hold community trainings on CBPR and will select two teams of stakeholders to design and implement unique projects using CBPR methods. The CBPR teams will each select a problem specific to health care access for African Americans with mental illness and will investigate this problem scientifically. CBPR teams are viewed as active participants during all aspects of the research process and are provided with training and capacity to support implementation and evaluation. For more information see www.chicagohealthdisparities.org.

#### Thomas C. Irving

**TITLE:** Elastic Proteins in the Flight Muscle of Manduca sexta

**INVESTIGATORS:** Thomas C. Irving (PI), Chen-Ching Yuan, Weikang Ma, Peter Schemmel, Yu-Shu Cheng, Jiangmin Liu, George Tsaprailis, Samuel Feldman, and Agnes Ayme Southgate

#### FUNDING AGENCY: National Science Foundation

The physiological behavior of the flight muscles of the Hawkmoth, Manduca sexta have a number of similarities to mammalian heart muscle despite a number of differences in structure. In a recent paper in Science (George et al., 2013) we also showed that the force producing myosin cross bridges in the muscle could behave as actuators or springs depending on the temperature of the muscle and the patterns of nervous stimulation. So it appears that Manduca flight muscle can be used not only as a model system for some aspects of cardiac muscle contraction but also as an inspiration for new types of adaptive actuators which could have wide applications in technology. In order to fully understand the Manduca muscle system, we need to understand the proteins responsible for its passive elastic properties as well as its active properties. In this study we used protein chemistry,





biophysical and genetic methods to identify no less than six elastic proteins in Manduca flight muscle, including two that had never been seen before in an insect flight muscle. We were able to identify the gene sequences for all of these muscles and were also able to demonstrate that the different portions of the muscle tune the amounts of each elastic protein to their different physiological function, either as actuators or springs. These studies, therefore, filled in an important and previously unknown void in our knowledge of how these muscles operate.

#### Adam S. Hock

TITLE: Intermediate Temperature Hybrid Fuel Cell System for the Conversion of Natural Gas to Electricity and Liquid Fuels

**INVESTIGATORS:** Adam S. Hock (PI), Yunjie (Jerry) Xu, Guanghui Zhang, Carlo U. Segre, Theodore R. Krause, Deborah Myers, and Balu Balachandran



FUNDING AGENCY: Department of Energy, Advanced Research Projects Agency - Energy (ARPA-E)

This project is aimed at converting stranded natural gas reserves into a transportable fuel using an intermediate temperature fuel cell device. It combines catalysis innovations of the Hock group and Argonne National Laboratory collaborators with Argonne's innovative fuel cell program. ARPA-E funds highpotential, high-impact energy technologies that are too early for private-sector investment. ARPA-E awardees are unique because they are developing entirely new ways to generate, store, and use energy.

#### **Miles Wernick**

**TITLE:** Predictive policing with the Chicago Police Department

**INVESTIGATORS:** Miles Wernick (PI). Yongyi Yang, and Jovan G. Brankov

FUNDING AGENCY: National Institute of Justice



Illinois Tech researchers in the Medical Imaging Research Center have applied machine learning techniques to predict crime in Chicago and software is now in use at the Chicago Police Department (CPD). The team has produced several software products for CPD: 1) an algorithm that identifies the persons in Chicago with the very greatest risk of being involved in a shooting in the upcoming time period; 2) an algorithm that forecasts tomorrow's number of violent crimes: and 3) a web dashboard that allows real-time visualization of crime statistics, identifying out-of-the-ordinary numbers that

may signal a significant issue. This year, Professor Yang became principal investigator of a major new project with CPD to optimize the use of video surveillance in policing and evaluate the role of video analytics.

#### **Mohammad Shahidehpour**

**TITLE:** Research, Development, and Testing of the Bronzeville Community Microgrid (BCM)

**INVESTIGATORS:** Mohammad Shahidehpour (PI) and Zuyi Li

FUNDING AGENCY: U.S. Department of Energy (DOE)

A team of Illinois Tech faculty and students is conducting research, development, and testing of a community microgrid system with applications to the BCM. The proposed BCM project will develop an interconnected system of microgrids and offer a test plan in Chicago's Bronzeville community to establish the first DOE-funded demonstration of community microgrids in the United States. The project team includes Illinois Institute of Technology, ComEd, OSIsoft, Microsoft, Argonne National Laboratory, Alstom Grid, Quanta Technology, University of Denver, S&C Electric, and Schneider Electric Company. BCM utilizes state-of-the-art technologies provided by the team members (such as the Microsoft NextCity platform and OSIsoft PI System) for a successful community microgrid implementation. The Illinois Tech Mies campus, one of the seven DOE pilot microgrid prototypes, a smart grid center of excellence, and a longtime Bronzeville resident, currently operates and maintains its generation and demand response assets that play a role in supporting the microgrid operations. The Illinois Tech Microgrid has demonstrated the higher reliability and the economics of microgrid operations and offered a distributed system design that can be replicated in urban communities. The stated vision for the DOE-funded project is to position BCM as a platform that will be interconnected with the Illinois Tech Microgrid to provide enduring benefits to the Bronzeville neighborhood. The BCM project will benefit from the Illinois Tech's experience for offering broader energy efficiency perspectives to key stakeholders with keen interests in enhancing the economics, reliability, security, and the resilience of the nation's electricity grid. The BCM architecture will be based on the already developed and tested electrical system at the Illinois Tech Microgrid that employs robust hierarchical control and protection. The successful implementation of BCM will meet critical milestones necessary to demonstrate the effectiveness of distributed generation that can provide a cost-effective alternative to the expansion planning of traditionally centralized power generation and transmission systems. The BCM project will engage utility customers as significant participants that can fulfill the economics, reliability, security, and the resilience mandates of a smart electricity infrastructure.

#### Zhiling Lan

**TITLE:** Toward Smart HPC through Active Learning and Intelligent Scheduling

**INVESTIGATOR:** Zhiling Lan

FUNDING AGENCY: National

Science Foundation, Division of Computer and Communication Foundations

Being analogous to smart grids, this project aims to develop critical technologies toward smart supercomputing by incorporating intelligence into resource management and job scheduling. Specifically, it will develop a framework named SPEaR (Scheduling for Performance, Energy, and Resilience efficiency) for dynamically optimizing the three-dimensional performance, energy, and resilience scheduling. The research focuses on two thrusts. One is active learning to automatically extract valuable performance, energy, and resilience patterns and tradeoffs out of application and system data; the other is intelligent scheduling to adaptively control performance, resilience, and energy efficiency in resource management and scheduling. Completion of the project will make important advances toward efficient use of extreme scale systems. The close partnership with national laboratories and application scientists will enable the integration of this work into broader programs and activities of national interests.

#### Lori B. Andrews

**TITLE:** Monitoring Health on the Go: the Privacy Implications of Diabetes Apps

**INVESTIGATORS:** Lori B. Andrews, Sarah R. Blenner, Adam J. Rouse, Nadia Daneshvar, Melanie Köllmer, and Curry Williams

FUNDING AGENCY: Cy Pres Award / Diabetes

Mobile health apps help individuals manage chronic health conditions, maintain independence, build skills, and take on increasing responsibility for the prevention, diagnosis, and treatment of diseases. One-fifth of smartphone owners have mobile health apps; these apps can provide a repository for data, including compliance with medication regimens, activity notes, and symptoms. This interdisciplinary project analyzed what happens to the information collected by mobile health apps related to diabetes and whether potential users are sufficiently informed about what data will be collected, analyzed, and shared. Mobile apps that collect, share, and use digital health data expose consumers to serious privacy risks. For example, if a data aggregator provides information to a life insurance company regarding an applicant who has installed several diabetes-related apps or entered unhealthy glucose levels, that insurance company might raise its rates or might refuse to issue a policy. Yet despite these risks, our study found that users are generally inadequately warned about risks.



Only 19% of the diabetes apps had privacy policies. We found that sensitive information from diabetes apps is routinely shared with unrelated third parties (86% of the apps placed third-party cookies on the user's device and 77% shared information with ad networks or data analytics companies). There was no statistically significant difference in the collection or sharing of information based on whether or not the app had a privacy policy.

#### Liad Wagman

**TITLE:** The Impact of Access to Consumer Data on the Competitive Effects of Horizontal Mergers

**INVESTIGATORS:** Liad Wagman (co-PI), Jin-Hyuk Kim, and Abraham Wickelgren

**FUNDING AGENCY:** Federal Trade Commission of South Korea

Improvements in information technology have brought growing concerns about privacy intrusion to the forefront of public debate. Nearly all US consumers now use online media to shop, more than 60 percent of US consumers own smartphones, and over two thirds of online adults in the US are now registered on social networks. As recent reports by the US Federal Trade Commission show, this has lead to the proliferation of so-called data brokers. These brokers collect consumers' personal, behavioral, and financial data from a wide range of sources; connect, aggregate, and analyze these disparate elements of consumers' online footprints to form detailed individualized profiles; and subsequently sell this data to be used downstream for a variety of marketing purposes across industry sectors. The extent of such consumer profiling may be best described by this quote:

"Of nine data brokers, one data broker's database has information on 1.4 billion consumer transactions and over 700 billion aggregated data elements; another data broker's database covers one trillion dollars in consumer transactions; and yet another data broker adds three billion new records each month to its databases. Most importantly, data brokers hold a vast array of information on individual consumers. For example, one of the nine data brokers has 3000 data segments for nearly every U.S. consumer" (FTC, 2014).

In this project, our aim is to provide an economic analysis of the effects of consumer data on mergers. More specifically, we examine the influence of firms' ability to target individualized pricing on the welfare consequences of horizontal mergers. Our early findings show that in a three-to-two firm merger, the post-merger loss in consumer surplus is reduced when firms have access to consumer data compared to when they do not -- this is due to a reduction in the anti-competitive effects of the merger. In contrast, the analogous reduction is absent in a two-to-one firm merger. Therefore, the merger effects of access to consumer data are strongly dependent on market structure.



#### Weslynne S. Ashton

**TITLE:** Pathways to Cleaner Production in the Americas

**INVESTIGATORS:** Weslynne S. Ashton (PI) and Nasrin R. Khalili

**FUNDING AGENCY:** Higher Education for Development, U.S Department of State

The Pathways to Cleaner Production in the Americas project aimed to identify and create strategies for improving sustainability practices among micro, small and medium enterprises (MSMEs) in Latin America and the Caribbean through industry-university collaboration. The project created an experiential education platform through which students in each of seven host countries learned about cleaner production (CP) by performing environmental audits in MSMEs, and assessing and recommending CP opportunities to the companies. This interaction between industry and academia was the basis for research on sustainability education and implementation in Latin America. One of our research themes examines the impact of experiential education on student learning and competencies developed through practicum courses and internships. Another explores trends in CP opportunities identified and implemented across industry sectors and countries to comprehend the desirability and viability of various options in relation to firm-level economic and strategic priorities as well as national-level sustainable development imperatives. We also investigate the barriers that MSMEs face with respect to implementing cleaner production practices and clean technology, and explore approaches for overcoming those barriers at the firm and policy levels. Overall, it is expected that this program will contribute to understanding how small businesses can incorporate sustainability practices in their operations, diffusing sustainable manufacturing practices in MSMEs across the region, and educating future environmental professionals throughout the Americas.

#### George M. Langlois

**TITLE:** Critical Mass Program Evaluation Program

**INVESTIGATORS:** George M. Langlois (PI) and Sean Wright



**FUNDING AGENCY:** Chicago Public Schools (CPS) as part of a grant from the U.S. Navy

In June of 2014, the CPS's Critical Mass Program, funded through the U. S. Navy, awarded the Center for Research and Service (CRS) in the Lewis College of Human Sciences a two-year grant to monitor and evaluate programs designed to increase interest in STEM careers within the military. The grant's primary objectives include creating a systematic program of data collection to enable CPS's Board to track quantitative and qualitative data, measure progress and identify areas for improvement in order to redirect the limited resources available. CRS will provide the following services:



• Develop high quality student and teacher surveys that allow the Board to monitor perceptions of the program, identify programs and activities with the most impact, and track students' post-secondary aspirations and teachers' professional development;

• Develop a system of administering quantitative and qualitative surveys and collect and store the results to provide comprehensive reporting on teacher and student feedback;

Create reports that evaluate CPS-supplied student and program data and determine efficacy of individual programs, activities and events while advising how best to allocate resources;

- Generate quarterly and annual reports on the key performance indicators (KPI) of the department, including at the student, program, and school level (as appropriate): e.g., student achievement and performance, professional development, program impact and sustainability, student interest in STEM, abrupt career/ coursework changes, college, and the U.S. Navy;
- Provide users with comprehensive reports that make them aware of the goals of each student and program and where each stands in regards to achieving those goals; and
- Advise the Board's project manager and develop the strategy for rolling out the survey system across CPS Critical MASS programs and supporting implementation.

#### Britt Burton-Freeman

**TITLE:** Functional plant components for prevention and management of metabolic and endothelial disturbances: a focus on Anthocyanin rich plant foods.

**INVESTIGATORS:** Britt Burton-Freeman and Indika Edirisinghe

**FUNDING AGENCY:** California Strawberry Commission and National Processed Raspberry Council

Diabetes afflicts more than 347 million people worldwide and is expected to be the seventh leading cause of death in 2030. Diet and lifestyle modification are the cornerstones of disease prevention and management. Certain polyphenolic compounds from various plant sources exhibit biological activities that promote glycemic control through insulin-dependent and -independent pathways offering potential adjunctive health promoting opportunities. Berry fruits provide a unique source and composition of polyphenolic compounds, particularly anthocyanin compounds. Our in vitro cell culture data have demonstrated enhanced activation of insulin signaling mediated through insulin receptor substrate -1 (IRS-1) tyrosine phosphorylation and phosphoinositide-3 kinase (PI3)/ Protein kinase B (Akt)/-dependent pathways; and in separate experiments vasodilator activity via endothelial and nitric oxide dependent mechanisms with

crude extracts of strawberries and other anthocyanin rich berries. The work of this project aims to translate the basic science research to clinical application understanding the role of anthocyanins and their metabolites in vasodilation responses and insulin sensitivity. The project will incorporate a host of biological assays and methods, including development of targeted and non-targeted analytical methods to identify and characterize key anthocyanin metabolites substantiating anthocyanin intake with their biological effects. Furthermore, we propose to develop computational methods based on molecular docking methodology to identify reliably and classify (as active or inactive) molecules that interact with a series of diabetes related molecular targets (in collaboration with David Minh, Division of Biological Chemistry).

#### Vijay K. Ramani

**TITLE:** Anion Exchange and Bipolar Membranes for Electrochemical Energy Conversion

INVESTIGATOR: Vijay K. Ramani

#### FUNDING AGENCY:

Office of Naval Research



The overarching objective of this project is to establish fundamental insights into the ion conduction, stability and alkaline degradation mechanisms of anion exchange membranes (AEMs) used as electrolytes in electrochemical energy conversion and storage devices. The underlying context is the application of AEMs as separators in alkaline membrane and bipolar membrane fuel cells, direct borohydride fuel cells, borohydride/ hydrogen peroxide fuel cells, flow batteries, and alkaline membrane water electrolyzers. Our work in this regard has enabled the design of higher performance and more durable AEMs. Specifically, our work has established structure-property relationships for different backbones and head group cation chemistries used in AEMs and has helped ascertain how their structure influences ion conductivity and alkaline stability. The AEMs produced in our laboratory have been used to prepare bipolar membranes and membrane electrode assemblies for hydrogen and direct borohydride fuel cells. Special attention has been given to the implementation of these bipolar membranes in borohydride/hydrogen peroxide fuel cells used as power sources in unmanned underwater vehicles. The AEMs have been adapted for use in redox flow batteries (exploiting the Donnan exclusion effect to enhance battery efficiency) and in solid

alkaline water electrolyzers for hydrogen production.



**TITLE:** Combining measurements and models to predict the impacts of climate change and weatherization on indoor air quality and chronic health effects in U.S. residences



**INVESTIGATOR:** Brent Stephens

FUNDING AGENCY: U.S. Environmental Protection Agency

The objectives of this proposal are to use a combination of field measurements and a nationally representative set of dynamic residential indoor air quality models to predict indoor exposures and associated chronic health effects of several priority pollutants of both indoor and outdoor origin across (1) the current residential building stock; (2) the residential building stock under future climate scenarios of 2050 and 2080; and (3) the future building stock under both future climate scenarios and future climate policies that lead to widespread application of weatherization retrofits and turnover of the existing building stock to more energy efficient homes. A set of nationally representative indoor air quality models will be used to predict longterm concentrations and health risks, with a number of key input parameters informed by results from novel field experiments performed in 30 existing homes both before and after weatherization retrofits are applied. The field measurements will include ventilation rates, infiltration factors, indoor deposition rates, and envelope penetration factors for a number of priority pollutants.

#### Carlo Segre

**TITLE:** Materials Research Collaborative Access Team

**INVESTIGATORS:** Carlo Segre

**FUNDING AGENCY:** U.S. Department of Energy

The continuing operations of the Materials Research Collaborative Access Team (MRCAT) are supported by its member institutions that provide the funds to Illinois Tech to hire the staff and operate the two beamlines for the members' experiments using x-ray absorption spectroscopy to study catalysis, environmental systems, batteries, and fuel cells. The MRCAT beamline has a 60cm long flat harmonic rejection mirror with Pt and Rh coatings. This mirror resides in the experimental station and may be moved vertically in or out of the beam as the experiment requires. In addition to Illinois Tech, the members of MR-CAT include UOP Honeywell, BP Research, the U.S. Environmental Protection Agency, the Chemical Sciences Division at Argonne National Laboratory (ANL), and the Environmental Research Group at ANL.

#### **Alvin Lee**

**TITLE:** Building Capacity to Control Viral Food-borne Disease: A Translatonal, Multi-Disciplinary Approach



INVESTIGATORS: Lee-Ann Jaykus, Robert Atmar, Steve Beaulieu, Jennifer Cannon, Mary Estes, Angela Fraser, Aron Hall, Alvin Lee, Christine Moe, Jan Vinje, Leonard Williams, and Liju Yang

**FUNDING AGENCY:** USDA, National Institute for Food and Agriculture

The project is a multi-disciplinary, integrated approach to develop appropriate tools and skill set to study food-borne viral agents, and to use these tools and knowledge to systematically identify risk factors and develop intervention and risk management strategies for reducing viral contamination in pre- and postharvest. The project is funded by USDA for 5 years with a \$25 million research budget involving 9 key partners and 20 collaborating research institutions with North Carolina State University as the lead university. The consortium, USDA Food Virology Collaborative or affectionately known as NoroCORE, aims to reduce the burden of food-borne diseases associated with viruses. As one of the key partners, Dr. Lee serves on the Executive Board and leads the Prevention and Control CORE where mitigation and control strategies will be developed and evaluated for their efficacy in inactivating food-borne viruses in specific food matrices.

#### Leon Shaw

**TITLE:** Scalable Manufacturing of Novel Hydrogen Storage Materials with Control at Nanometer Length Scales



**INVESTIGATOR:** Leon Shaw

#### FUNDING AGENCY:

National Science Foundation

Fuel-cell vehicles can convert fuel to energy without greenhouse gas emission in addition to their greatest conversion efficiency among the competing technologies (e.g., internal combustion engines, plug-in hybrids, and battery-powered automobiles). However, one of the major issues that hinder widespread adoption of fuelcell vehicles is the inadequate hydrogen storage system for on-board applications. This project is to investigate methods that can manufacture a large quantity of novel hydrogen storage materials with control at either atomic or low-nanometer length scales. We focus on a transformative manufacturing method, termed as Ball Milling with Aerosol Spraying (BMAS), initiated by the PI's group to enable a precise control in the mixing of complex hydrides and metal hydrides at low-nanometer length scales. The LiBH4+MgH2 system is investigated because the LiBH4+MgH2 system has been predicted by ab initio density functional theory (DFT) calculations to have

favorable thermodynamics for reversible hydrogen storage near ambient temperature. Furthermore, the LiBH4+MgH2 system has material-based storage capacities of 11.5 wt% H2 and 95g H2/L, which can be translated into the system-based storage capacity of 6.9 wt% H2 and 57g H2/L, respectively (if a 60% efficiency of hydrogen storage systems is assumed), surpassing the DOE 2015 FreedomCAR system targets. Mixing LiBH4 and MgH2 at the low-nanometer level will overcome the significant kinetic barriers of the LiBH4+MgH2 system and transform a thermodynamically favorable hydrogen storage material into a kinetically viable system that can meet the DOE 2015 FreedomCAR targets with high gravimetric and volumetric storage capacities while being capable of quick uptake and release near ambient temperature.

#### **Tomasz Bielecki**

**TITLE:** Topics in stochastic processes and mathematical finance: counterparty risk valuation and hedging, Markov consistency and Markov copulae, and dynamic performance assessment indices



FUNDING AGENCY: National Science Foundation

The aim of the research is to develop new mathematical methods for risk management in complex stochastic dynamical systems, such as financial markets. In view of the world-wide market turbulence in the past decade, and taking into account the known causes of it, such as mismanagement of the counterparty risk, particular emphasis is put on mathematical aspects of dynamic management of counterparty risk. The research is logically divided into three areas. The first area is that of mathematical modeling for the purpose of financial risk management, with application to hedging, valuation, and management of counterparty credit risk (CCR). This kind of risk is one of the key risks born by market participants trading so called over the counter (OTC) derivatives. Development of tractable mathematical tools for the purpose of valuing and managing of counterparty risk embedded in a large variety of the OTC contracts provides the risk managers with new methodologically sound procedures, and, consequently, may contribute to increased stability of financial markets, and the whole economy.

The second area is that of application of stochastic analysis to studying of structured dependence between so called Feller Markov processes. Besides its theoretical importance in the study of random processes, it is of practical importance in view of important applications, such as valuation and hedging of counterparty credit risk and systemic risk.

The focus in the third area is on mathematical modeling of dynamic performance assessment indices with applications to conic finance. Dynamic performance assessment indices are measures of performances of a given activity in a random environment, and they are studied from abstract mathematical point of view.



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