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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,

Dennis Roberson  
Vice Provost for 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 $15,649,037. 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 $195,284,339. Since proposals often yield 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 six STEM-Fieldhouse fellowships to two students in 2015. This year’s winners were Luy 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 11th 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 undergraduates winners were: 1st place: Yusra Sarhan (BME), advised by David Mogul (BME); 2nd place: Ritika Dhawan (BMS), advised by Georgia Papavasiliou (BME); and 3rd place: Georgi Hristov (MMAE), advised by David Williams (MMAE). The graduate winners were: 1st place: Martin Detoria (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. Workshops 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).

 highlights from the Office of Research

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Over view of Proposals and Awards

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

<table>
<thead>
<tr>
<th>TOTAL NUMBER OF PROPOSALS SUBMITTED</th>
<th>TOTAL NUMBER OF AWARDS</th>
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<tr>
<td>FY11</td>
<td>FY12</td>
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<tr>
<th>TOTAL DOLLAR AMOUNT REQUESTED (IN THOUSANDS)</th>
<th>TOTAL DOLLAR AMOUNT AWARDED (IN THOUSANDS)</th>
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<tbody>
<tr>
<td>FY11</td>
<td>FY12</td>
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<td>$300,000</td>
<td>$250,000</td>
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*American Recovery and Reinvestment Act (ARRA)
Illinois Tech Research

Proposals

New Awards/IDC

New Awards

Revenue/Indirect Cost
Overview of Awards, Revenue, Expenditures, and Recovered Costs

TOTAL DOLLARS AWARDED EACH FISCAL YEAR (IN THOUSANDS)

TOTAL REVENUE BY FISCAL YEAR (IN THOUSANDS)

AWARDS AND EXPENDITURES (IN THOUSANDS)

ADMINISTRATIVE AND FACILITIES COSTS AWARDED AND RECOVERED (IN THOUSANDS)

DOLLARS REQUESTED

NUMBER OF PROPOSALS SUBMITTED

DOLLARS AWARDED

NUMBER OF AWARDS

*American Recovery and Reinvestment Act (ARRA)

* IIT Research Institute (IITRI)

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
Proposals and Awards by College: Total FY13-15

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

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
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

**Illinois Tech’s Top Researchers**

**PRINCIPAL INVESTIGATORS WITH RESEARCH REVENUE EXCEEDING $1,000,000 IN FY15**
- David Baker
- Robert Brackett
- Patrick Corrigan
- Tom Irving
- Reginal Jones
- Carlo Segre
- Mohammad Shahidehpour
- Miles Wernick

**PRINCIPAL INVESTIGATORS WITH RESEARCH REVENUE BETWEEN $500,000-$1,000,000 IN FY15**
- Weslyne Ashton
- Ali Cinar
- Alex Flueck
- George Langlois
- Boris Pervan
- Vijay Ramani
- Dennis Roberson
- Leon Shaw
- Jay Sieber
- Jeffrey Terry

**PRINCIPAL INVESTIGATORS WITH AWARDS TOTALING MORE THAN $1,000,000 IN FY15**
- David Baker
- Robert Brackett
- Britt Burton-Freeman
- Tom Irving
- Reginal Jones
- George Langlois
- Mohammad Shahidehpour
- Miles Wernick

**PRINCIPAL INVESTIGATORS WITH AWARDS TOTALING $500,000-$1,000,000 IN FY15**
- Patrick Corrigan
- Adam Hock
- Zhihling Lan
- Alvin Lee
- Ioan Raicu
- Vijay Ramani
- Carlo Segre
- Brent Stephens
- Yagmur Torun

**PRINCIPAL INVESTIGATORS WITH COMBINED AWARDS TOTALING MORE THAN $2,000,000 FOR FY13-15**
- David Baker
- Britt Burton-Freeman
- Adam Hock
- Zhiling Lan
- Alvin Lee
- Ioan Raicu
- Carlo Segre
- Mohammad Shahidehpour
- Leon Shaw

**PRINCIPAL INVESTIGATORS WITH COMBINED AWARDS OF $1,000,000- $2,000,000 FOR FY13-15**
- Shlomo Argamon
- Weslyne Ashton
- Eric Brey
- Britt Burton-Freeman
- Hyun-Soon Chong
- Adam Hock
- Zhihling Lan
- Francis Lane
- George Langlois
- Alvin Lee
- Dennis Roberson
- Mohammad Shahidehpour
- Leon Shaw
- Jeffrey Terry
- Yagmur Torun
- Philip Troyk
- Chris White

**PRINCIPAL 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

**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**
EDUCATIONAL AND RESEARCH INITIATIVE FUND (ERIF) WINNERS

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

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

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 Heterogeneity 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 Weslyyne Ashton
  Agent-Based Models as a Platform for Interdisciplinary Research of Complex Social and Business Systems
- Georgia Papavasiliou and Foud 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 (SERS) to Explore the Ecotoxicity 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 Histology to In Vivo 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 FACILITY
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 Gian
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

RESEARCH ACADEMY
Ali Cinar
Patrick Corrigan
Tom Irving
Philip Nash
Boris Pervan
Ganesh Raman*
Shangping Ren
Dennis Roberson, Chair
Carlo Segre
Xian-He Sun
Miles Wernick
Chris White
David Williams
Yongyi Yang

RESEARCH COUNCIL
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David Gidalevitz
Joel Goldhar
Nancy Karuri
Glenn Krell*
Norm Lederman
Eun-Jeong Lee
Shuwang Li
Vedran Mimica
David Mogul
Joseph Orgel
Krishna Pagilla
Domenica Pappas*
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Wei Zhang

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Andy Howard
Oscar Johnson
Brad Katz
Glenn Krell
John Kriegshauser
Tim Morrison
Sheldon Mostovoy
Zabel Panosyan
Charles Uth

*Ex-Officio Member
various departments currently
a base to coordinate the activities
general public sectors. It serves as
educational institutions and to the
continued development of
for interdisciplinary activities
CAPP provides a locus
AND PARTICLE PHYSICS
academia, and government pool their
knowledge-based outcomes in the
AND HEALTH
scientists and technicians conducts
IITRI’s staff of approximately 100
contract research affiliate. With
IIT RESEARCH INSTITUTE (IITRI)
developing mathematical and
CCSD provides an interdisciplinary
Argonne National Laboratory.
involvement through a close working
substantial increases in such
involved in a number of research
the center is home to interdisciplinary
Research and Education, the Center
Collaborative Access Team operate
for the Molecular Study of Condensed
Research and Education, the Center
Medical Imaging Research Center, the
and engineering research activities
the Illinois Tech campus. The
Medical Imaging Research Center, 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,
developing mathematical and
calculational tools 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; multilateral
systems; complex networks and
adaptive systems; natural and
industrial ecologies; dynamics of
multivariate systems; fluid turbulence,
molecular-level modeling of physical
systems; brain electrophysiology and
computational neuroscience; and
transportation systems.

THE CENTER FOR ELECTROCHEMICAL
SCIENCE AND ENGINEERING
WISER's mission is to
enhance research and educational
resources and the environment
while preserving our natural
life and positively impact society.
WISER's mission is to
WANGER INSTITUTE FOR
ENERGY RESEARCH
(WISER)
Conference on the Molecule 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 membrane engineering, and biological
mimetics, entangled polymers, networks, and the cytokine.
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
Rayleigh Scattering; micro- and
bulk rheology; molecular dynamics
simulations; and statistical and
mechanical modeling.

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 movements and movements
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, Gregory F. 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 RESEARCH
(CINNIR)
CINNIR's mission is to
foster collaborative research in
systems and brain 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 to public interest
interdisciplinary approaches
to understanding the complex
behavior of the nervous system.

THE CENTER FOR SELECTIVE
PARTICLE PHYSICS
(TCSPP)
the center is committed to multi-disciplinary
and multi-institutional research to
projects that combine empirical
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 with 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
enable the university, companies,
organizations, and governmental
units to be proactive and
innovative in meeting the
challenges of 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
CSEP Center’s mission is to
educate students as responsible
professionals, to reflect on the wider
implications of scientific progress,
and to explore the emergence 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 medical and ethical aspects of
neuroscience. The Ethics Center
is committed to multi-disciplinary
and multi-institutional research to
projects that combine empirical
processing equipment including high
pressure processing, retorts and a
fresh produce processing line.

IT RESEARCH INSTITUTE (IITRI)
IITRI is Illinois Tech’s not-for-profit
contract research affiliate. With
focus on biomedical research,
IITRI’s staff of approximately 100
scientists and technicians conducts
programs for both governmental
and commercial sponsors. Specific
areas of expertise include preclinical
toxicology, carcinogenesis and
cancer prevention, mass spectrometry,
technology, molecular biology,
analytical chemistry, and biodefense.

INSTITUTE FOR FOOD SAFETY
AND HEALTH
IFISH is a world-class
research institute that produces
innovative, practical solutions in
the areas of food safety, food defense,
and nutrition for stakeholders in
government, industry, and academia.
IFISH 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 25 years, IFISH has
provided a collaborative environment
where scientists from industry,
academia, and government can
utilize their scientific expertise and
institutional perspectives to ensure the
production of safe, wholesome foods.
IFISH 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
a unique 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.

THE CENTER FOR ELECTROCHEMICAL
SCIENCE AND ENGINEERING
The center is devoted to
research primarily in fuel cells and
cellular batteries, while preparing
students for careers in advanced energy
technology.

THE CENTER OF EXCELLENCE
IN POLYMER SCIENCE AND
ENGINEERING
In November 1990, the center is home to interdisciplinary
research and education that advances
cell and polymer science and engineering.
Research encompasses synthesis,
characterization, and processing of polymers.

THE CENTER OF EXCELLENCE
IN NEUROSCIENCE AND
ENGINEERING
CINNR's mission is to
foster collaborative research in
neuroscience. The Ethics Center
focuses on philosophical and ethical
aspects 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 medical 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 and learning. It administrates a worldwide unique collection of ethics codes and a large collection of ethics education materials.

THE CENTER FOR SYNCHROTRON RADIATION RESEARCH AND INSTRUMENTATION (CSRR) 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 eliminating the 50,000 work zone injuries and 10,000 fatalities that occur every year. The initiatives of this center focus on (1) developing highway work zone safety audit guidelines by addressing the concerns and interests of all stakeholders; (2) discovering/developing 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 laboratories 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 (EC uD R) EC uD R’s objective is to use engineering and scientific techniques to develop treatment modalities for diabetes and its many complications. EC uD R 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 diabetes-related research projects. EC uD R 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 (FDC R) 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 high- and 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 (ICRC) The keynote of the ICRC’s mission is to “Rethinking Metropolis.” The architecture of the multiple, competing cities defining urban life in the new millennium. Urban migration and the proliferation of information technologies have focused the life of the metropolis on its premises and architectural values of the traditional city. We can no longer use 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 cultural, social, economic, and biological sciences, but it will also demand a particular talent and sensibility that the cultural 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, consuls, and four-ished 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 actually stepped forth with a dynamic vision. The purpose of the ICRC-Research Center is to promote and promulgate invention - to proffer a new vision.

THE INTERNATIONAL CENTER FOR SENSORS SCIENCE AND ENGINEERING (IC S S E) The mission of the Center is to foster communications within the scientific and engineering community about sensors and exchange experiences with academia, industry and research labs through support of scientific, student and faculty research and exchanges and to provide an interdisciplinary environment for broader areas of sensor research. The ICSS 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 in the work environment, more energy efficient usage, earlier diagnosis and effective treatment of diseases, and safer food.

THE MEDICAL IMAGING RESEARCH CENTER (MIRC) The Medical Imaging Research Center (MIRC), with offices at the Pritzker Institute of Biomedical Science and Engineering, is an interdisciplinary team focused on technological advances in the field of medical imaging, 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 associates, research associates, and labs. MIRC comprises 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. It also offers undergraduate degree programs in the ECE and BME departments. MIRC researchers span 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) The mission of the Galvin Center is to pursue groundbreaking work in the generation, transmission, distribution, management, and conservation 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 TP TC, 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, crossing technological solutions to industrial materials processing problems that are being developed by multi-disciplinary 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 mitigation and modeling. Applications are located in a variety of settings, including urban and unlicensed spectrum, public safety, smart grid, and spectrum sharing.
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-power generation, 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.

Service, Education, and Outreach Centers

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 training 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 Tsapralis, 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 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. Sigre, 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 high-potential, 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
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 and 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 BCM 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 Clean Energy Policy Institute 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 data collected during 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 power generation and transmission systems. The BCM project will engage utility customers as significant participants that can fulfill their economic, 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 tools and technologies toward smarter 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, energy, and resilience 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. Bilen-Askine, House, Nadia Dancheshv, Melanie Köllmer, and Curry Williams

FUNDING AGENCY: Cy Press Award / Diabetes Foundation

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 diabetes. Users of diabetes apps can provide a repository for data, including compliance with medication regimens 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 how 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 of 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 (96% of the apps shared 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 led to the proliferation of so-called data brokers. These brokers can access and aggregate personal and behavioral, and financial data from a wide range of sources; connect, aggregate, and analyze these disparate elements in the online footprint 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 the following: “One in 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 US consumer.” (FTC, 2014).

In this project, our aim is to provide an economic analysis of the effects of consumer data on mergers. More specifically, when combining the influence of a firm’s 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 analogical 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.
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 inform curriculum development and professional growth.

Develop a system of administering qualitative and quantitative 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 key performance indicators (KPI’s) of the department, including at the student, program, and school level (as appropriate): e.g., student achievement and performance, professional development and 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 Producers and 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, as well as protective 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; mediated through insulin receptor substrate -1 (IRS-1) anthocyanin compounds. Our in vitro cell culture data have composition of polyphenolic compounds, particularly sources exhibit biological activities that promote glycemic control through insulin-dependent and -independent pathways, as well as protective 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; mediated through insulin receptor substrate -1 (IRS-1) anthocyanin compounds. Our in vitro cell culture data have.

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 membrane fuel cells. Direct borohydride fuel cells, borohydride/ hydrogen peroxide fuel cells, flow batteries, and alkaline 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 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 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 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.
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

**INVESTIGATORS:** Tomasz R. Bielecki and Igor Cialenco

**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.