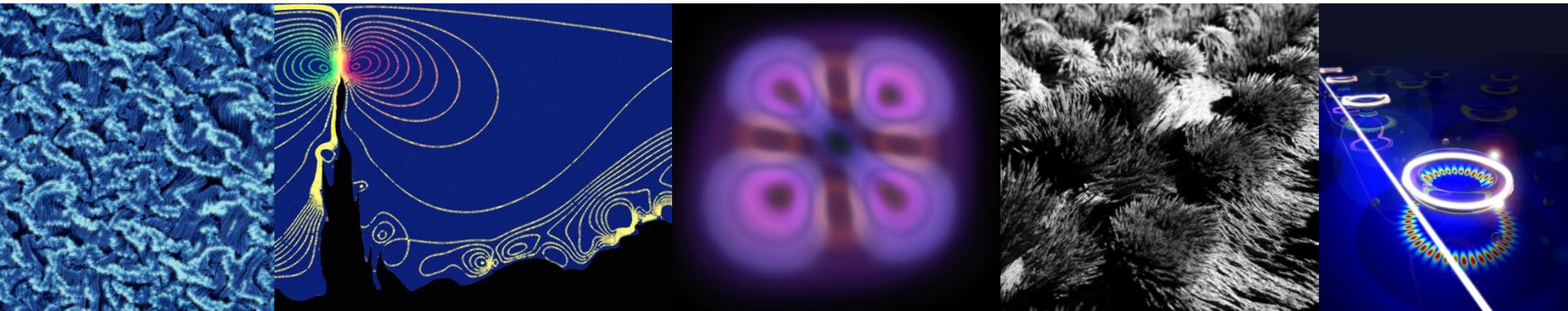
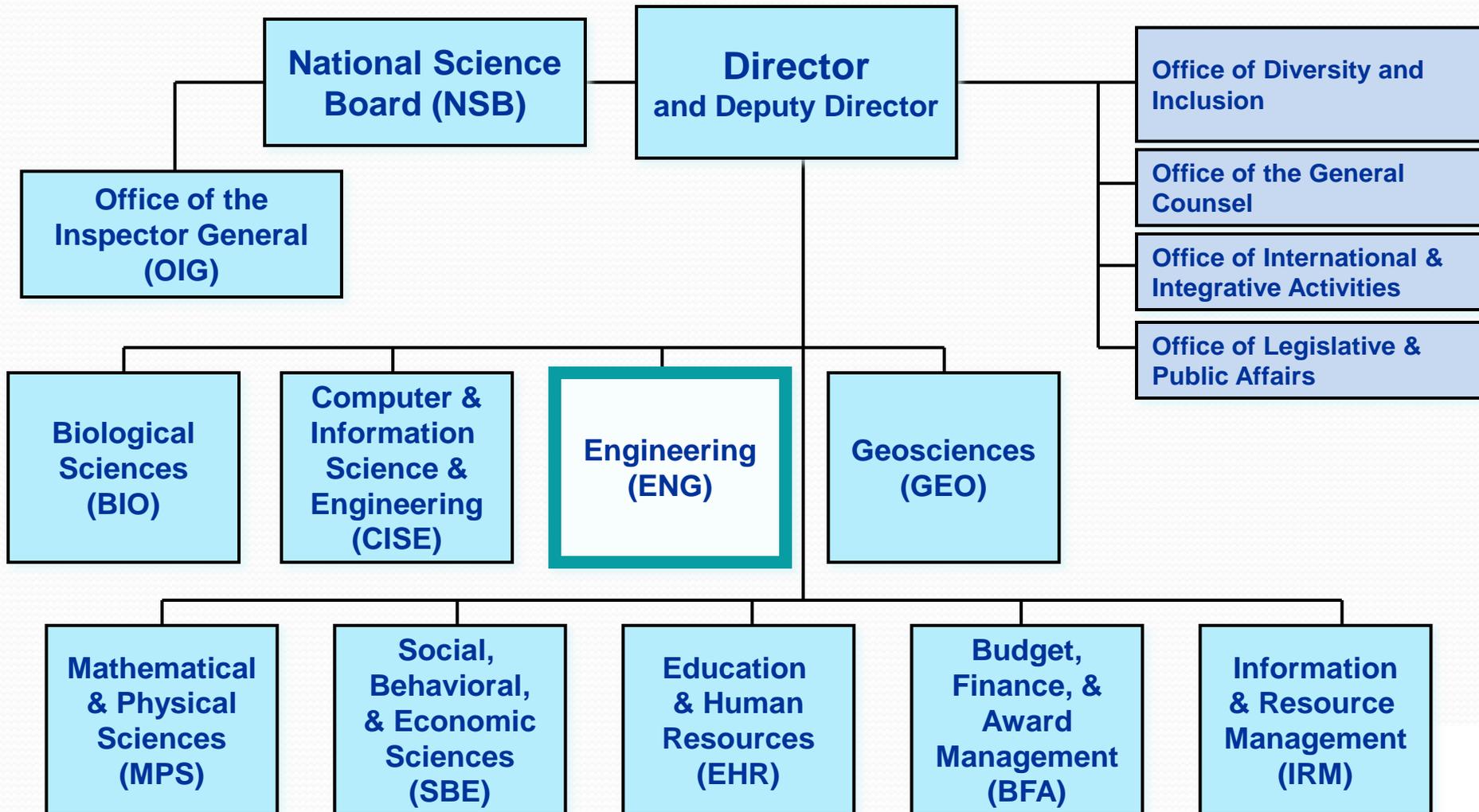


NSF Directorate for Engineering

Athanassios Sambanis
Regional Grants Conference
June 1-2, 2015



National Science Foundation

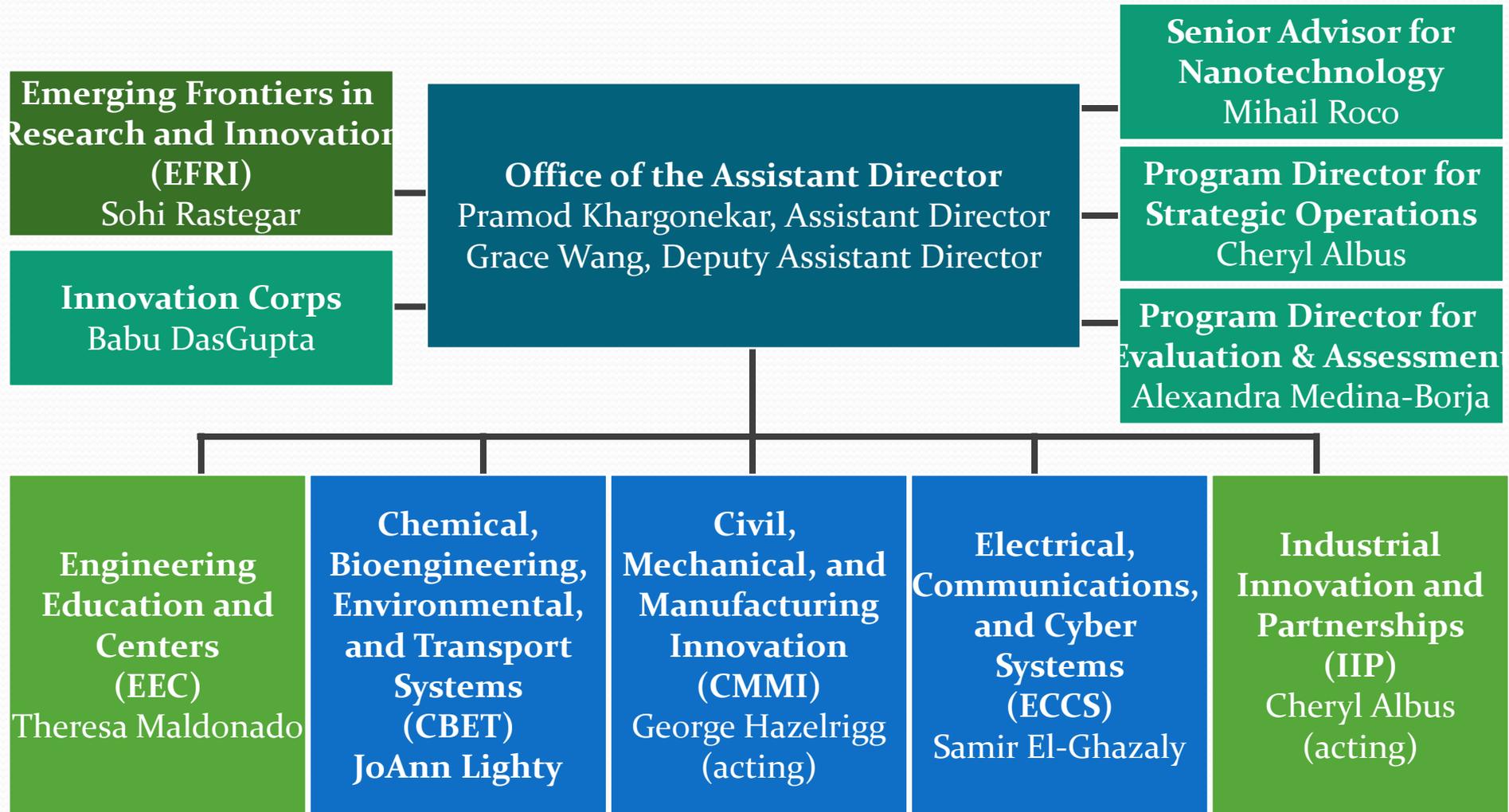


ENG Mission and Vision

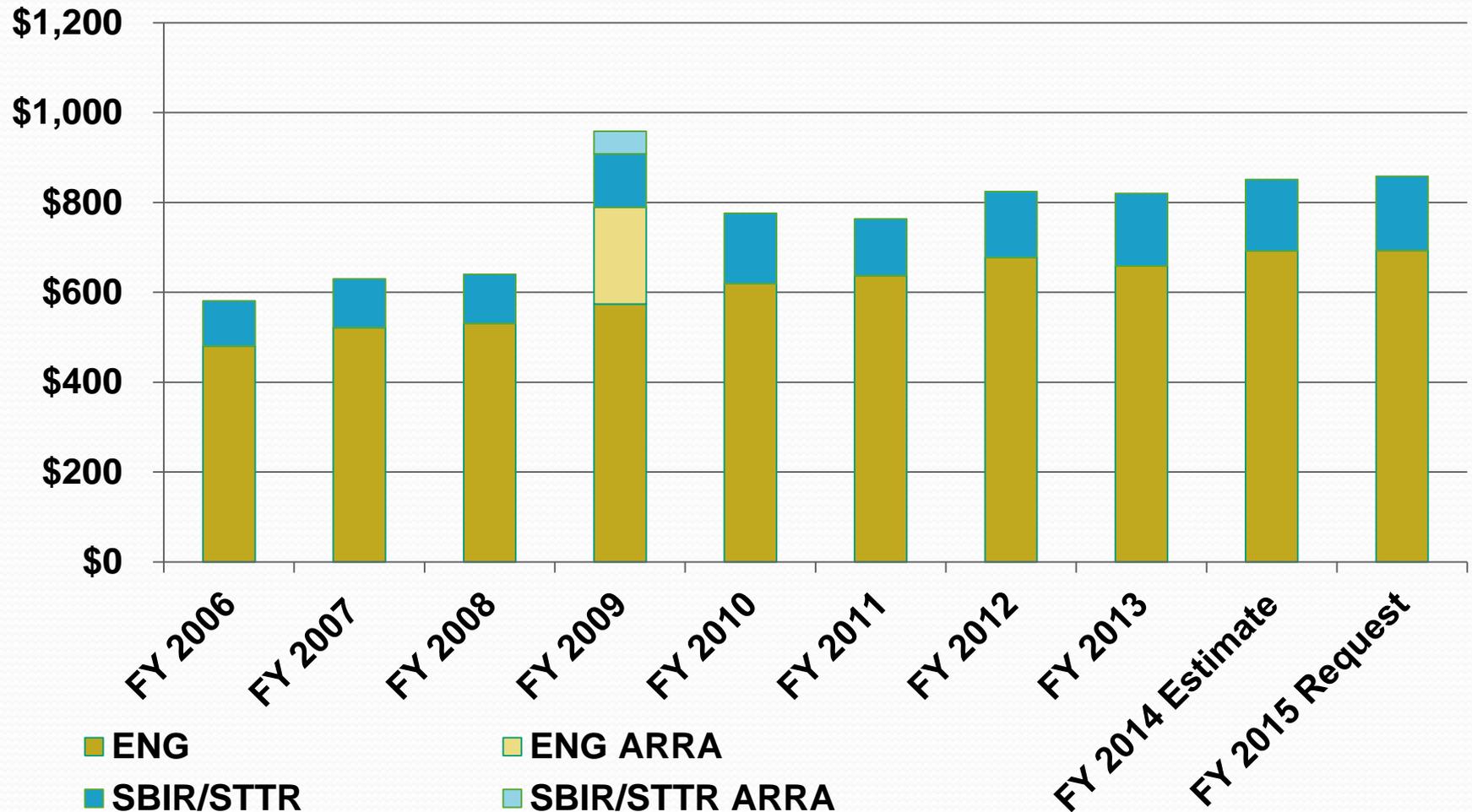
- **Mission:** To enable the engineering and scientific communities to advance the frontiers of engineering research, innovation, and education, in partnership with the engineering community, and in service to society and the nation.
- **Vision:** ENG will be a global leader in identifying and catalyzing fundamental engineering research, innovation, and education.



NSF Directorate for Engineering (ENG)



ENG and SBIR/STTR R&RA Budgets (\$M)



NSF ENG Strategy

- **Attract, stimulate, catalyze and challenge research communities to think big, enable transformational advances, and expand national innovation capacity**
- **Portfolio balance between fundamental, applied and translational as well as small, medium and large projects**
- **New approaches to address engineering education challenges**
- **Collaborate and partner within and outside NSF to maximize opportunity for the engineering research and education community to address major national priorities**



Disciplines in a Multidisciplinary World

- **NSF ENG has a strong commitment to fundamental engineering research**
- **How should we think about discipline based fundamental research in the contemporary research environment?**
- **Think of disciplines as super-nodes in the knowledge network**
- **Major opportunity: robust, effective linkages among nodes to solve tomorrow's problems**



Role of Grand Challenges

- **Grand challenges can be very useful in catalyzing major breakthroughs and advances**
 - NAE Grand Challenges in Engineering
- **Key characteristics:**
 - Big impact
 - Ambitious yet achievable
 - Compelling vision
 - Right level of specificity
- **How can the engineering research community use the grand challenge vehicle for big research achievements?**



Funding Opportunities

- **Core programs**
- **Exploratory research**
- **Collaborative/interdisciplinary areas**
- **Crosscutting and NSF-wide programs**



Funding

- **Proposals must address NSF goals**
 - Transform the frontiers of science and engineering
 - Stimulate innovation and address societal needs through research and education
- **NSF merit review criteria**
 - Intellectual merit
 - Broader impacts



Leaf sensor alerts when plants are thirsty

- The biotech and agriculture company, AgriHouse, developed a sensor that measures the water deficit stress in a plant.
- When a plant starts drying out, its leaves contract, which is reflected in a change electrical voltage.
- The sensor transmits those voltage changes to a cell phone, or computer, so a farmer can use the data to turn irrigation equipment on or off.
- In tests at the USDA research farm, beans attached to leaf sensors used 25 percent less water with the sensors than they did when watered using standard irrigation practices.
- The technology was first created by aerospace engineers and the doctoral research work of Hans-Dieter Seelig of the University of Colorado.

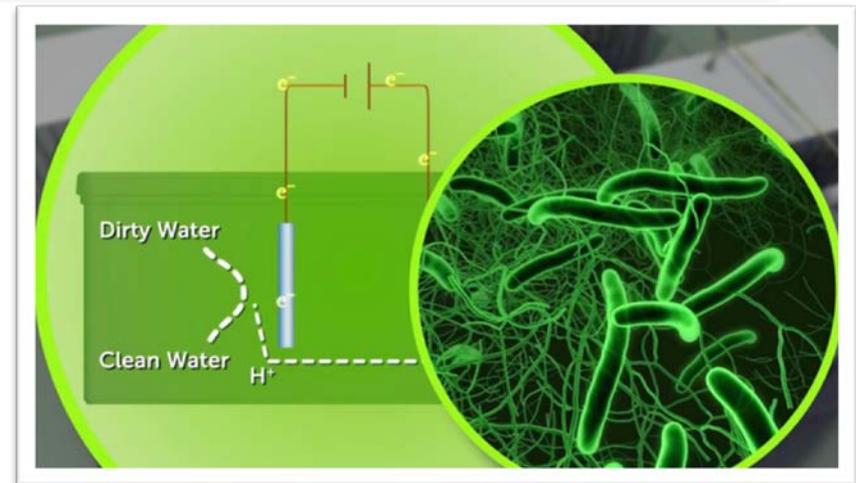
Image Credit: NSF



Generating energy from wastewater

- The Cambrian Innovation system, called EcoVolt, generates methane gas from the wastewater.
- The system sends wastewater through a bio-electrochemical reactor.
- As water filters through it, special bacteria in the reactor eat the organic waste in the water and release electrons as a byproduct.
- Those electrons travel through a circuit to generate methane, which is then burned to generate heat and energy.
- In a pilot at the Clos du Bois winery in Calif., it is saving the winery more than \$200K per year.

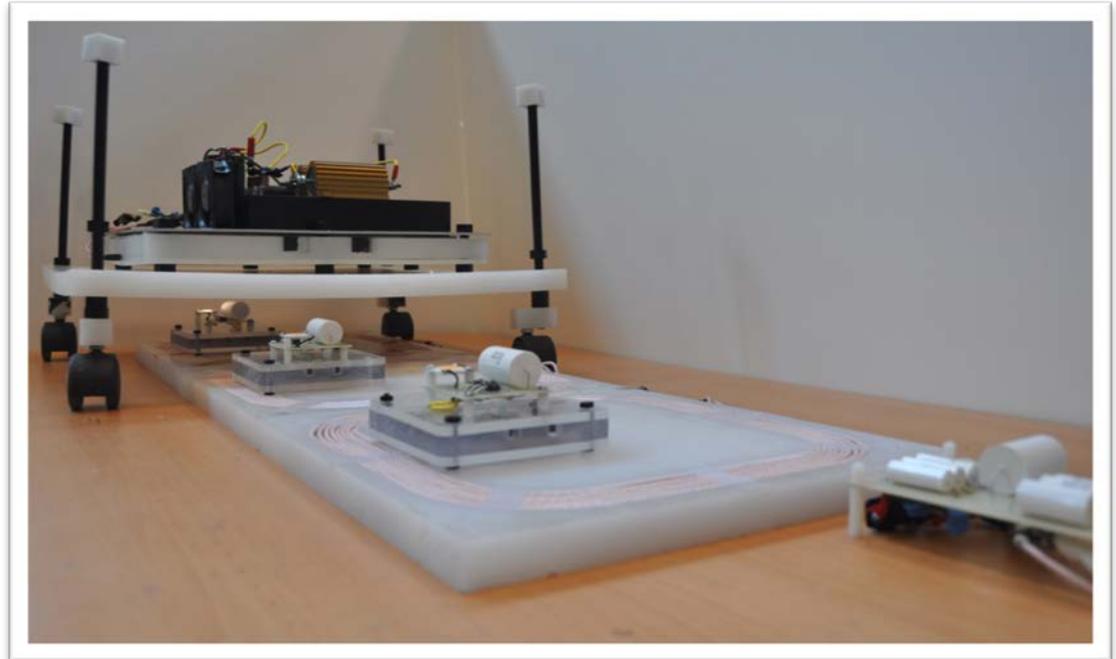
Images courtesy Cambrian Innovation



Wireless power transfer for vehicles

- Researchers at the FREEDM Systems ERC at North Carolina State University have developed new technology and techniques for transmitting power wirelessly from a stationary source to a mobile receiver.
- Srdjan Lukic and team developed a small, functional prototype of their system and are now working to both scale it up and increase the power of the system.
- This proof of concept brings them closer to their goal of creating highway "stations" that can recharge electric vehicles wirelessly as the vehicles drive by.

Image Credit: NCSU



Sensitive electrode locates areas for treatment

- Walt Besio, a biomedical engineer at the University of Rhode Island, has developed a more sensitive electrode that can conduct electricity into and out of specific brain areas.
- He has already used it to pinpoint areas to treat epilepsy, a brain disorder associated with abnormal electrical activity.
- With support from I-Corps and SBIR, Besio aims to make the electrodes commercially available.

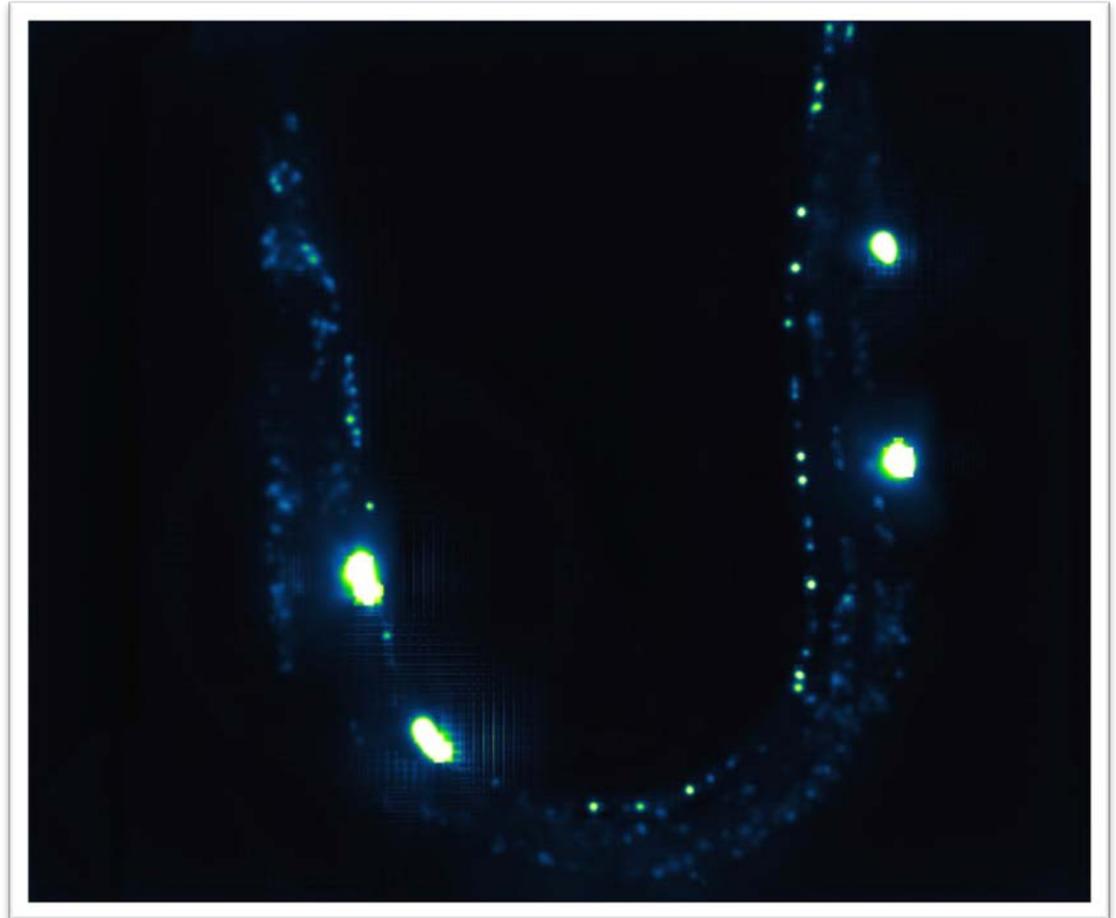
Image Credit: Joe Giblin, URI



Simultaneous functional imaging of all neurons

- Researchers led by Ed Boyden of MIT achieved simultaneous functional imaging of all the neurons of the transparent roundworm *C. elegans*.
- This technique is the first that can generate 3-D movies of activity across entire brains at the millisecond timescale.

Image Credit: MIT and University of Vienna



3-D printed implants for complex injuries

- Researchers adapt technology for 3-D printing metals, ceramics and other materials to create custom medical implants designed to fix complicated injuries.
- Materials scientist Susmita Bose and materials engineer Amit Bandyopadhyay of Washington State University are creating implants that more closely mimic the properties and shape of human bone, such as the skull.

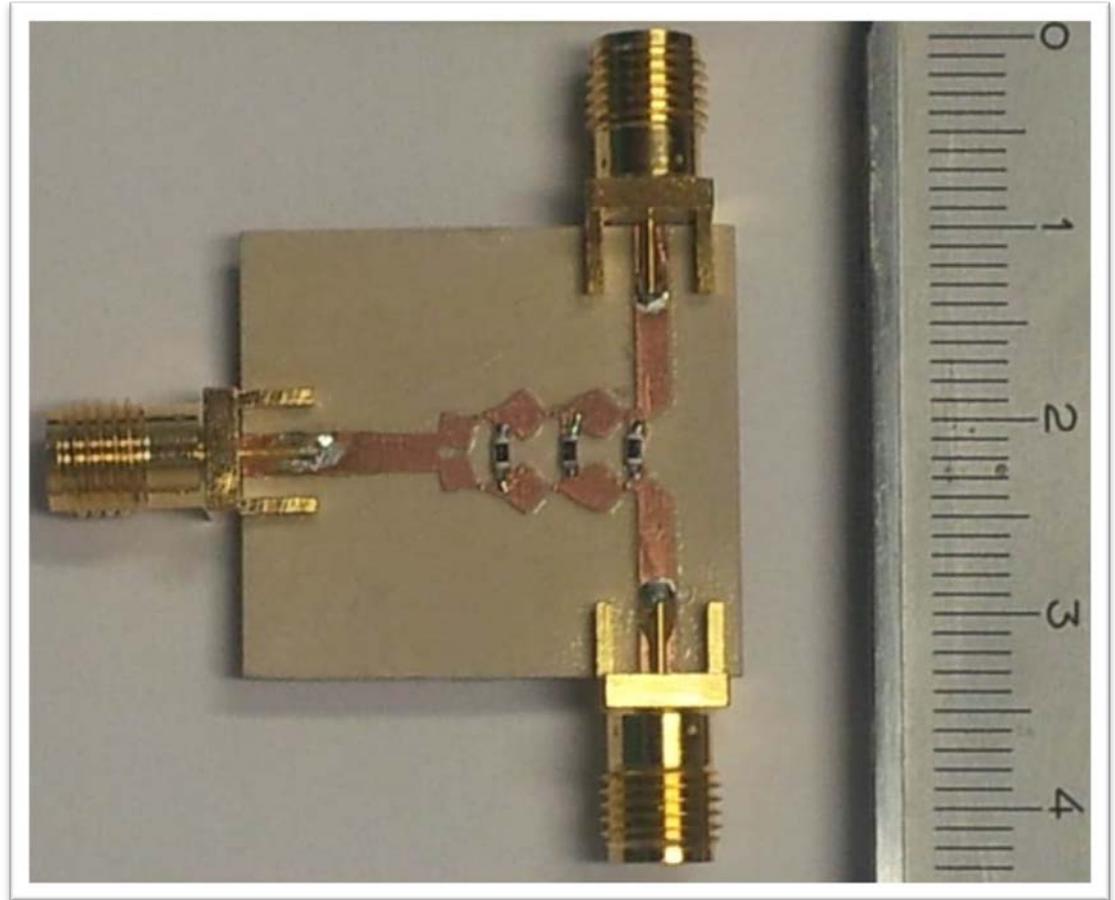
Image Credit: Robert Hubner, WSU Photo Services



New component design for cognitive radio

- Cognitive radio allows temporarily unallocated frequencies to be loaned to secondary users.
- For it to work, front-end microwave components must support cognitive radio operation over a wide frequency range (spectrum sensing).
- A team led by Vijaya Kumar Devabhaktuni at the University of Toledo designed and fabricated an effective low-cost, low-complexity power divider component that enables cognitive radio for ultra-wideband spectrum.

Image Credit: University of Toledo



Proposal Submission

- The right program for a proposal depends on the research objective
- The research goal is to obtain a fundamental understanding of...
- The research objective is to test the hypothesis...
- Winning proposals need both a research objective and a plan to accomplish the objective



NSF Supports Research

- Winning proposals focus on research, not development
- If the focus of the proposal is an artifact (a device, system, product, process,...), it's probably development
- If the focus of the proposal is knowledge (the truth of a hypothesis), it's probably research



Steps towards Successful Proposals

- Begin with
 - White paper
 - Dialog with program officer
 - Short biography
- Get involved with NSF reviews



Ethics

- Persons submitting proposals to the Federal government are held to high standards of conduct
- Misbehavior can be dealt with quite severely
 - PI barred from submission to NSF for up to 2 years
 - Permanently barred from proposal review
 - At least two cases of jail time (Grimes case, 42 months in Federal prison)
 - Maximum \$250,000 fine, 5 years in prison
- Institutions must train and verify

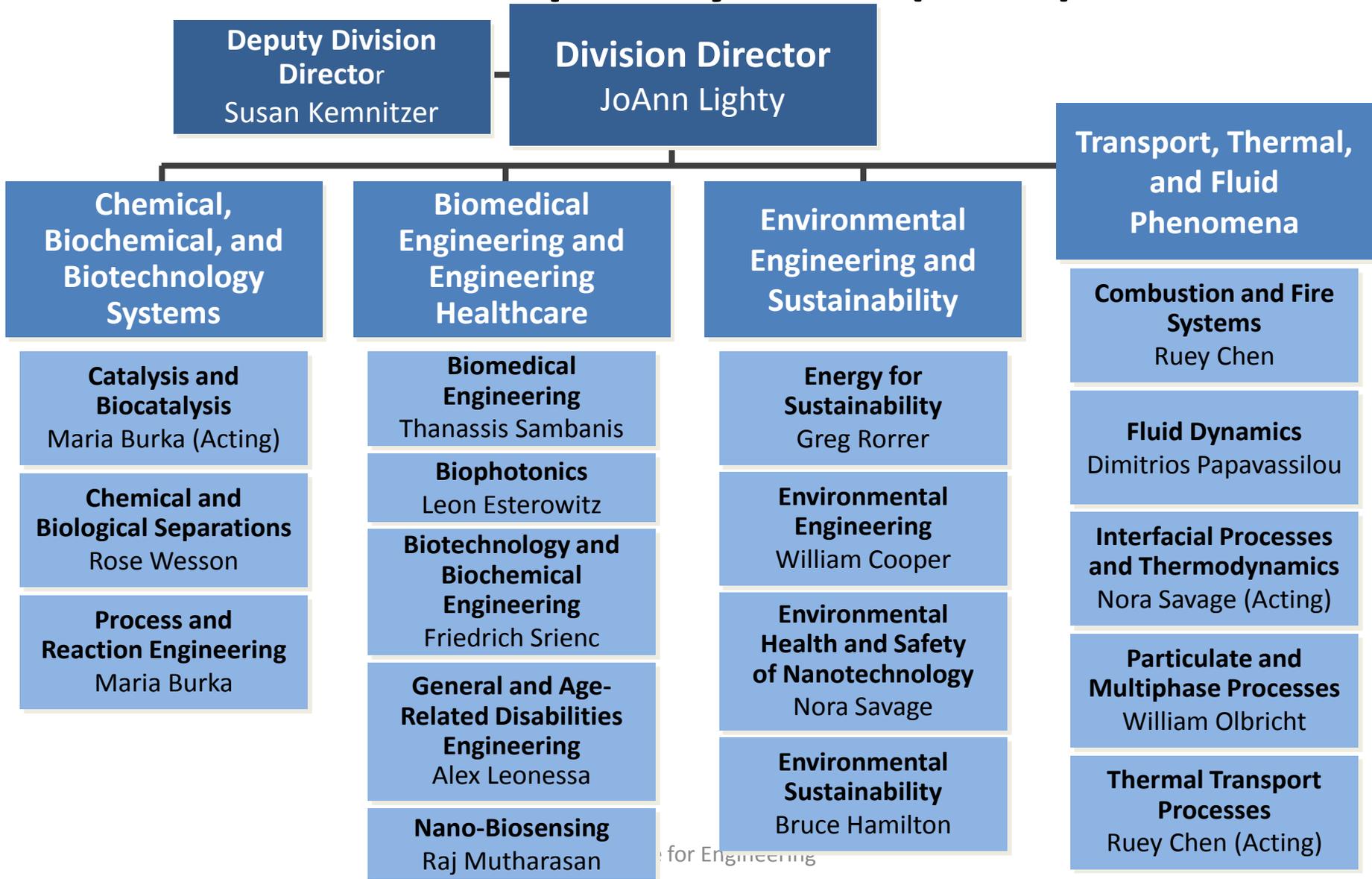


Major Forms of Misbehavior

- Plagiarism—uncited reproduction of the work of others
- Falsification—intentional misrepresentation of data or results (progress reports)
- Fabrication—making up data
- Double charges—billing the government twice for the same work



Chemical, Bioengineering, Environmental, and Transport Systems (CBET)



CBET Areas of Interest

Chemical, biochemical, and biotechnology

- processing and manufacturing of products with chemical and renewable resources

Biomedical engineering and engineering healthcare

- integration of engineering and life science to solve biomedical problems

Environmental engineering and sustainability

- reduction of adverse effects of solid, liquid, and gaseous discharges into land, waters, and air that result from human activity

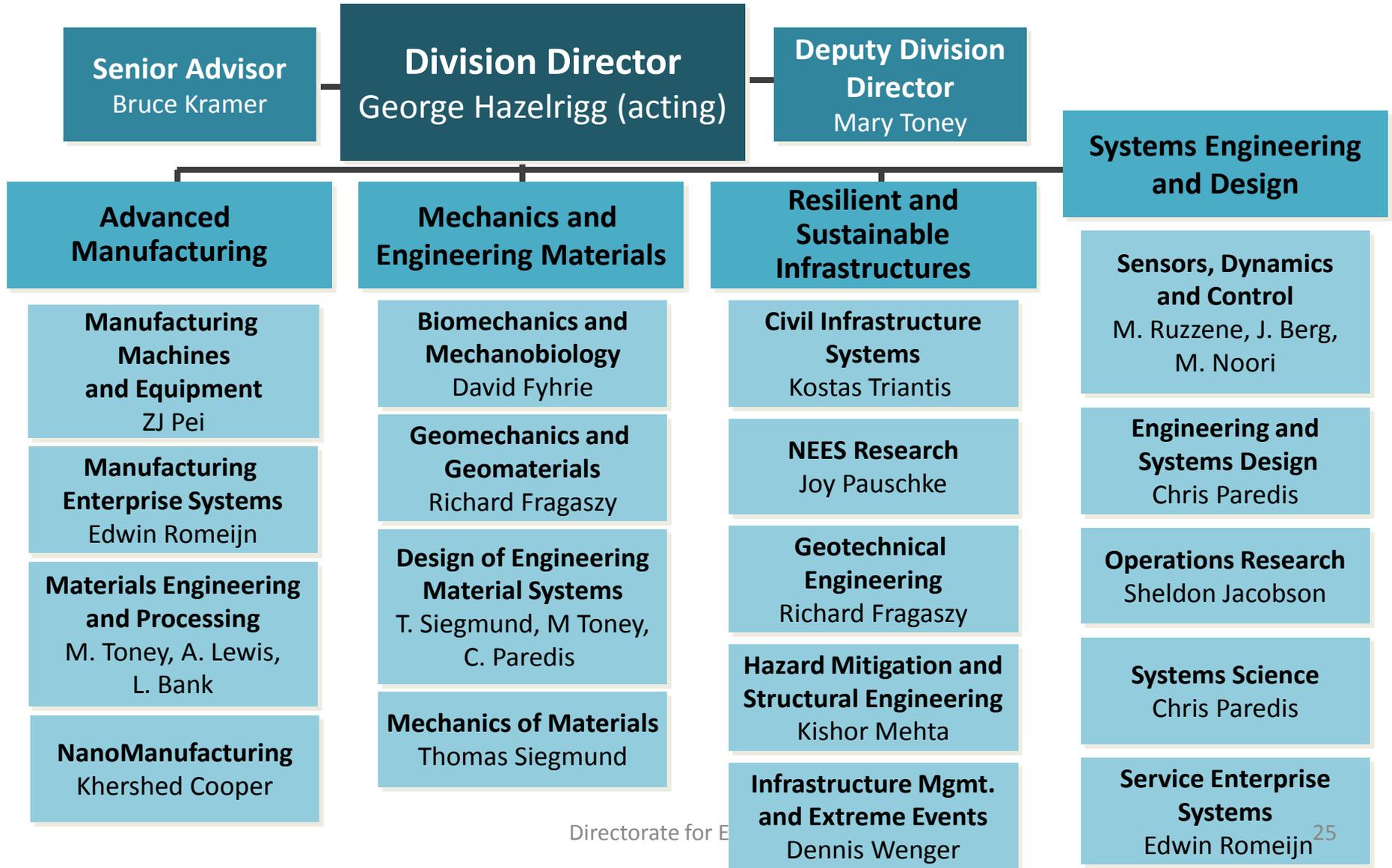
Transport and thermal fluids phenomena

- thermal, mass, and momentum transport that enable new technological solutions (energy, environment, manufacturing, health care, ...)

ONE submission deadline per year: October 1 - 20, 2015; October 1 - 20, Thereafter



Civil, Mechanical, and Manufacturing Innovation (CMMI)



CMMI Areas of Interest

Advanced Manufacturing

- transformative advances in manufacturing and materials processing, with emphases on efficiency, economy, sustainability and scalability

Mechanics and Engineering Materials

- understanding the properties and use of materials in engineered and natural systems

Resilient and Sustainable Infrastructures

- innovation to advance resilience and sustainability of civil infrastructure and distributed infrastructure networks

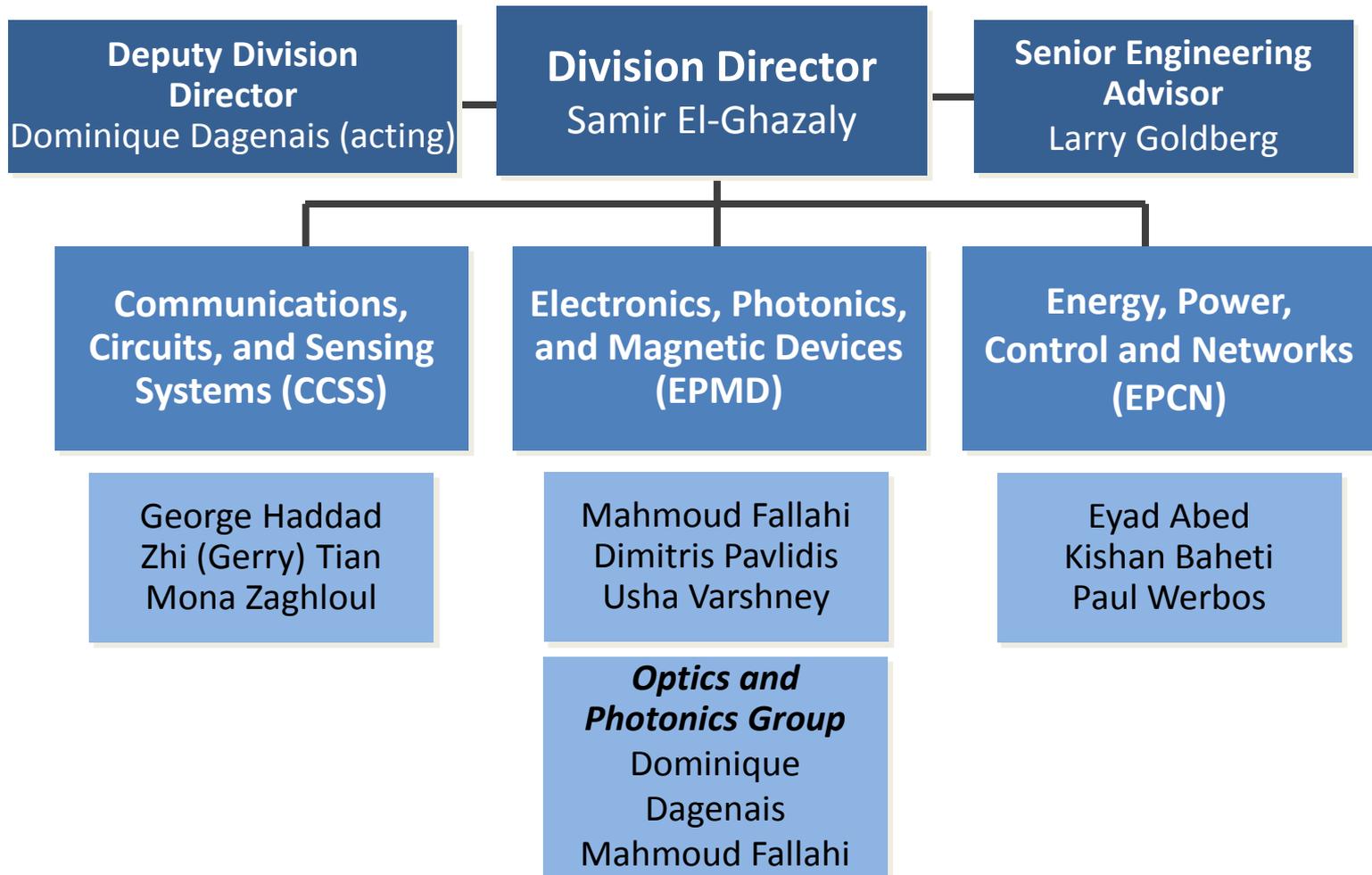
Systems Engineering and Design

- decision-making aspects of engineering, including design, control, optimization and systems science

TWO submission deadlines : September 1-15, February 1-17



Electrical, Communications, and Cyber Systems (ECCS)



ECCS Areas of Interest

- Fundamental research issues underlying device and component technologies, power, controls, computation, networking, communications and cyber technologies
- The integration and networking of intelligent systems at the nano, micro and macro scales
 - for healthcare, homeland security, disaster mitigation, energy, telecommunications, environment, transportation, manufacturing, and other systems-related areas
- ONE submission deadline per year: Nov. 3, 2014, and Nov. 1 annually thereafter



Emerging Frontiers in Research and Innovation (EFRI)

- **Supports higher-risk, higher-payoff opportunities that:**
 - Are potentially transformative
 - Address a national need or grand challenge
- **Recent topic areas:**
 - Flexible Bioelectronics Systems (BioFlex)
 - Origami Design for the Integration of Self-assembling Systems for Engineering Innovation (ODISSEI)
 - Photosynthetic Biorefineries (PSBR)
- **New topic announced in April 2013: 2-DARE**
 - 2-D Atomic-layer Research and Engineering
- **4-year awards at ~\$500K per year**



Engineering Education and Centers

Centers and Networks

Engineering Research Centers (ERC)

Keith Roper, Lead
Deborah Jackson
Carmiña Londoño
Mary Poats
Carole Read

Nanoscale Science & Engineering Centers (NSEC)

Carole Read
Keith Roper

Network for Computational Nanotechnology (NCN)

Eduardo Misawa
Keith Roper

Division Director (Acting)

Don Lewis Millard

Deputy Division Director

Don Lewis Millard

Engineering Education

Research in Engineering Education (REE)

Research Initiation Grants in Engineering Education (RIGEE)

CAREER

Ethics Education in Science and Engineering (EESE)

Donna Riley

Nanotechnology Undergraduate Education (NUE) in Engineering and Computer Science

Mary Poats

Engineering Workforce Development

Research Experiences for Undergraduates

Esther Bolding

Research Experiences for Teachers

Mary Poats

Broadening Participation in Engineering

Broadening Participation Research Initiation Grant (BRIGE)

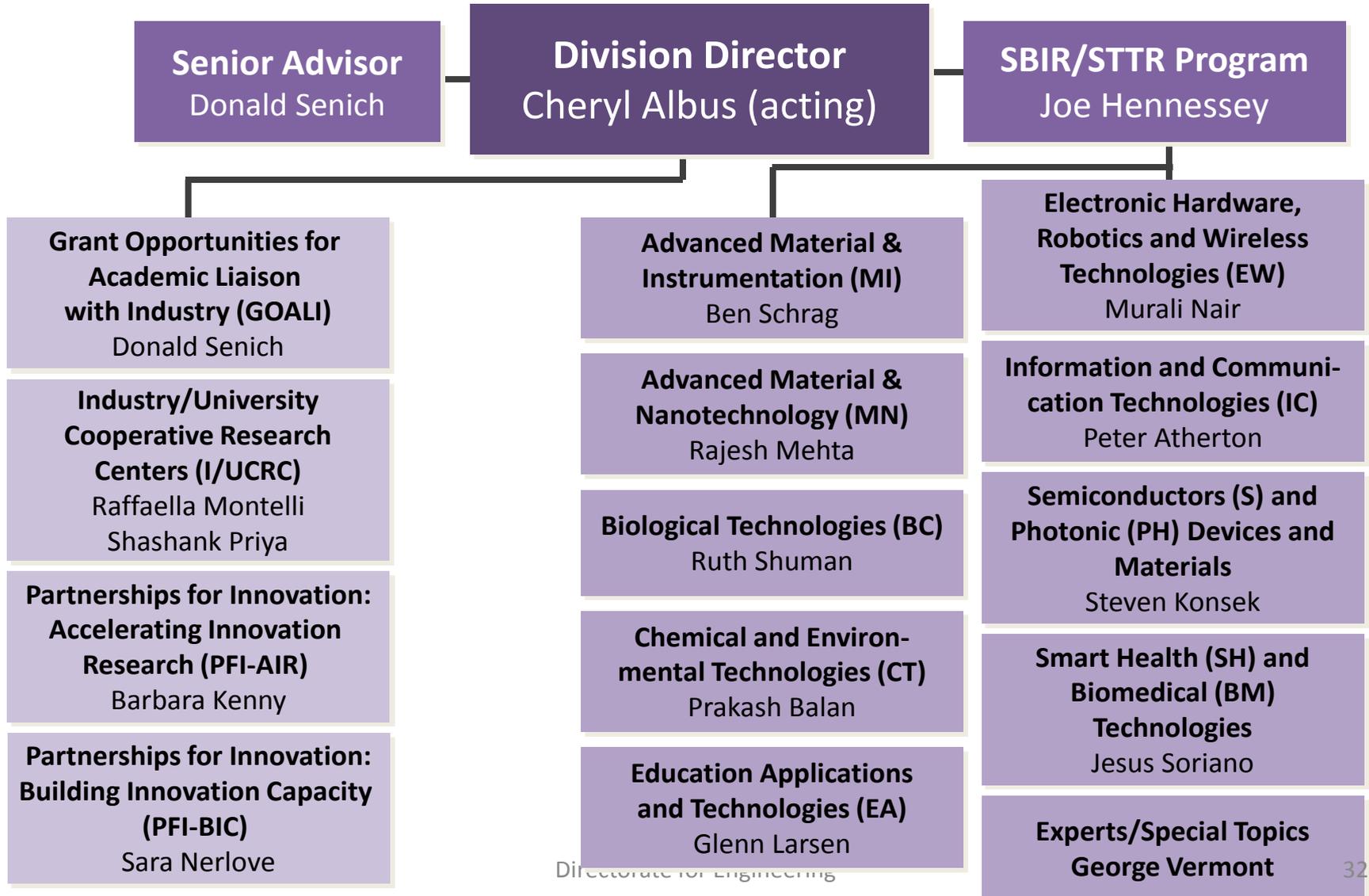
Bevlee Watford

Engineering Centers and Networks

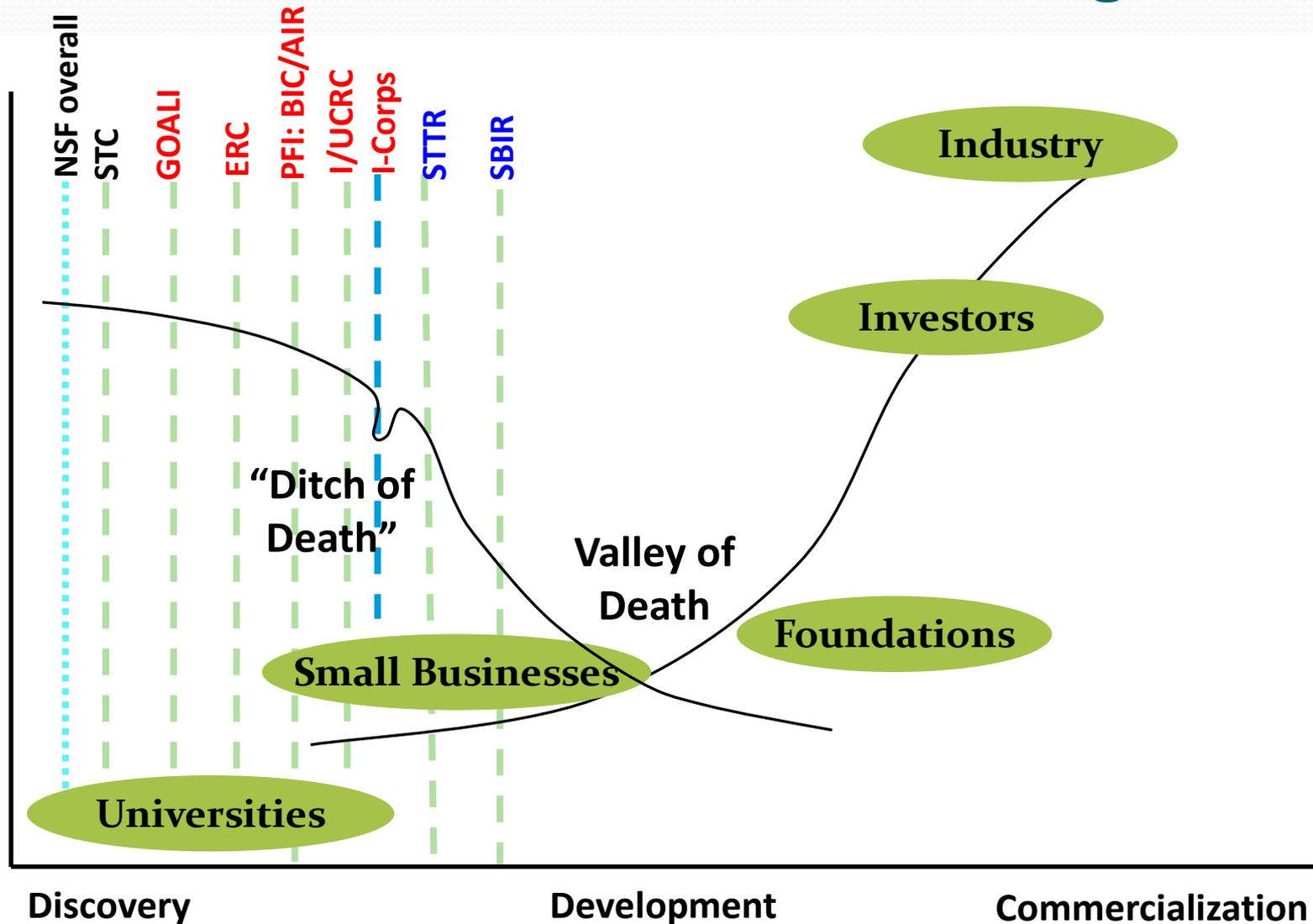
- **Large-scale research investments in ENG**
- **Supports collaboration with industry and other stakeholders** to promote innovative research and education
- **Engineering Research Centers (ERC)**
 - Three generations (50 centers total) since 1985
 - New Nano-Systems ERCs (NERCs) in FY12
- **Nanoscale Science and Engineering Centers (NSEC)**
 - 19 NSECs since 2001
 - 3 graduated NSECs from FY01 class
- **Network for Computational Nanotechnology**
 - Cyber-resource for nanotechnology theory, modeling and simulation
 - nanoHUB.org gateway for nanotechnology research and education
 - > 180k users globally

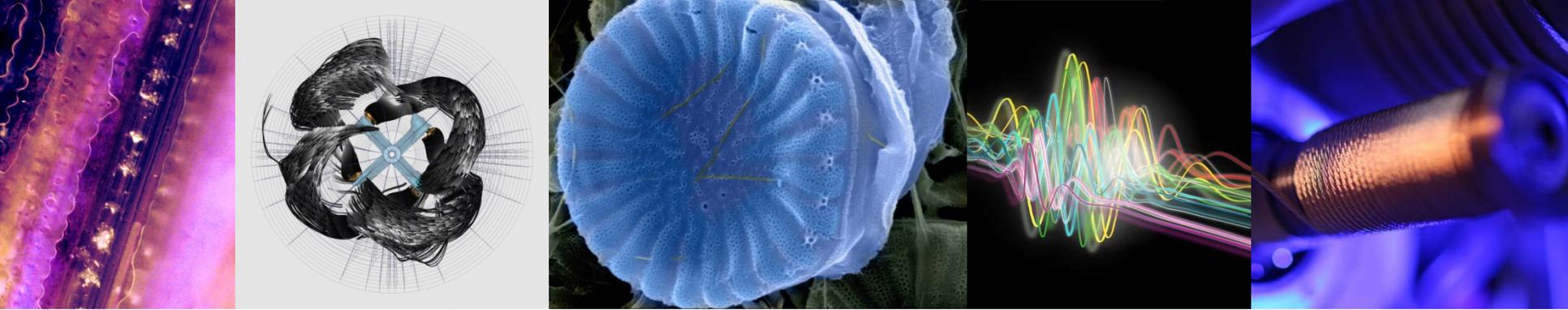


Industrial Innovation and Partnerships(IIP)

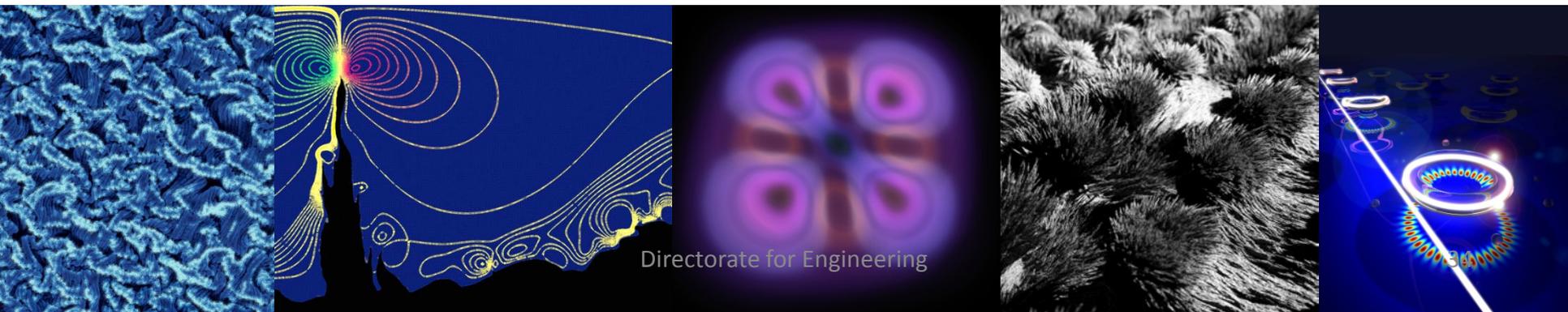


Research to Commercialization: Filling the Gap





ENG Investments and Crosscutting Programs



CAREER

- Foundation-wide activity that offers NSF's most prestigious awards for faculty members beginning their independent careers
- Provides stable support at a sufficient level and duration to enable awardees to develop careers as outstanding researchers and educators who effectively integrate teaching, learning, and discovery
- High priority for Engineering
- ENG award size increased to \$500,000
- *Note: the CAREER award is not just a research award, it is a career development award*



Crosscutting and NSF-wide Opportunities

- Collaborative Research in Computational Neuroscience (CRCNS)
- Critical Techniques and Technologies for Advancing Big Data Science & Engineering (BIGDATA)
- Cyber-enabled Sustainability Science and Engineering (CyberSEES)
- Cyber-Physical Systems (CPS)
- Innovation Corps (I-Corps)
- Integrative Strategies for Understanding Neural and Cognitive Systems (NSF-NCS)
- Interdisciplinary Research in Hazards and Disasters (Hazards SEES)
- National Robotics Initiative (NRI)
- Pan-American Advanced Studies Institutes (PASI)
- Partnerships for International Research and Education (PIRE)
- Research Coordination Networks
- Scalable Nanomanufacturing (SNM)
- Sustainability Research Networks (SRN)
- Sustainable Chemistry, Engineering, and Materials (SusChEM)



Closing Thoughts

- **NSF ENG is deeply committed to fundamental engineering research, education and people, and innovation for benefit to the nation**
- **We invite the engineering community to help us in embracing current opportunities and lay the foundations for a prosperous future for engineering**
- **This will require all of us to be creative, bold, collaborative, inclusive, and persistent**



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63 Photos and videos

TWEETS 1,343 PHOTOS/VIDEOS 63 FOLLOWING 140 FOLLOWERS 8,851 FAVORITES 177 More ▾

Tweets Tweets & replies

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News: Immersive robotics experience inspires future engineers: Underrepresented students are more likely to p... 1.usa.gov/1s3Btoe

NSF Engineering @NSF_ENG · Oct 3
News: President Obama honors nation's top scientists and innovators: President Obama today announced a new gro... 1.usa.gov/Z3kknJ

NSF Engineering @NSF_ENG · Oct 1
Workshop report for a future #nanotechnology infrastructure support program bit.ly/1vxTGcN #NNIN

NSF Engineering retweeted
UC Davis Engineering @UCDavisCoE · Sep 29

ENG Homepage, www.nsf.gov/eng



Email updates

- Funding opportunities
- Due dates

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Engineering - making imagination real

ENG Organizations

- Chemical, Bioengineering, Environmental, and Transport Systems (CBET)
- Civil, Mechanical and Manufacturing Innovation (CMMI)
- Electrical, Communications and Cyber Systems (ECCS)
- Engineering Education and Centers (EEC)
- Emerging Frontiers in Research and Innovation (EFRI)
- Industrial Innovation and Partnerships (IIP)

About ENG

- View ENG Staff Directory
- Search ENG Staff Directory
- General Information About ENG
- Career Opportunities
- Advisory Committee
- Budget Excerpt

Proposals and Awards

- Proposal and Award Policies and Procedures Guide

Perspective of the ENG Assistant Director

Dr. Pramod Khargonekar, NSF Assistant Director for Engineering, shares his thoughts on [emerging ideas, frontier research areas, and national needs](#).

Read the latest perspective on [neuroengineering](#).

Special Announcements

October 2, 2014 - The report from the August 2014 workshop on the Future Nanotechnology Infrastructure Support Program is [now available](#).

ENG Leadership Opportunities

ENG is seeking candidates for Division Director, Division of Industrial Innovation and Partnerships, through October 22, 2014. [More](#)

ENG is seeking candidates for Deputy Division Director in three divisions through October 6, 2014. [More](#)

Recently Announced Funding Opportunities [See All](#)

- [EMERGING FRONTIERS IN RESEARCH AND INNOVATION 2015](#) (NSF 15-502) Posted October 2, 2014
- [Partnerships for Innovation: Accelerating Innovation Research- Research Alliance](#) (NSF 14-612) Posted September 29, 2014
- [Integrative Strategies for Understanding Neural and Cognitive Systems](#) (NSF 14-611) Posted September 26, 2014
- [Partnerships for Innovation: Building Innovation Capacity](#) (NSF 14-610) Posted September 22, 2014

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Featured Programs

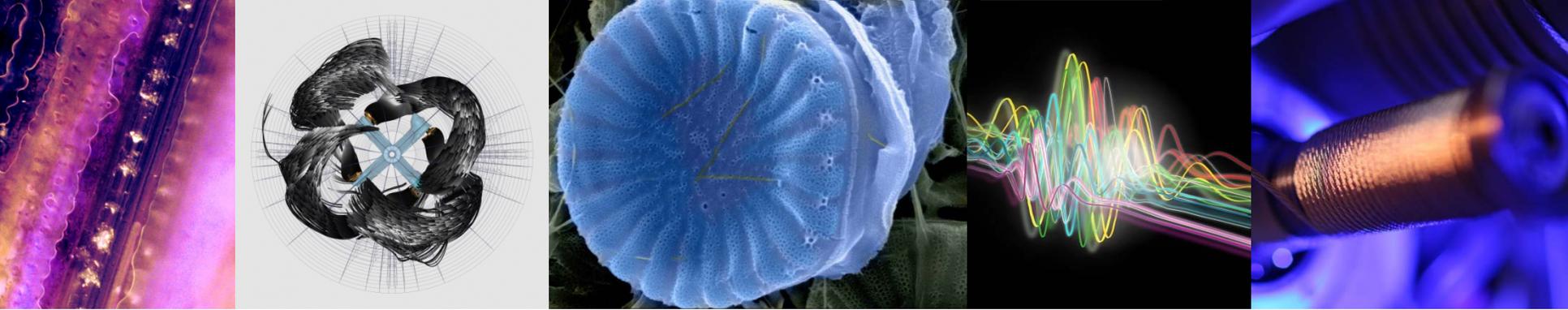
- Graduate Research Fellowship Program
- IUSE / Professional Formation of Engineers: Revolutionizing Engineering Departments
- Natural Hazards Engineering Research Infrastructure (2015 - 2019)

Additional ENG Resources

- ENG Committee of Visitor (COV) Reports
- NSF National Nanotechnology Initiative

Publications [See All](#)

- Dear Colleague Letter: FY 2015 Clean Energy Technologies Funding Opportunities
- Dear Colleague Letter: Closing of Program Solicitation NSF 14-511
- Dear Colleague Letter (DCL): Submission of I/UCRC Proposals in Response to NSF 13-594 in Areas Related to Understanding the Brain's



Questions ?

Image Credits (top, from left): Sijie Lin, Pu-Chun Ke, Clemson Univ.; Sumanta Acharya, Louisiana State Univ.; Gregory L. Rorrer, School of Chemical, Biological, and Environmental Engineering, Oregon State Univ.; Tenio Popmintchev, JILA and Univ. of Colorado at Boulder; Barrett Technology, Inc. www.barrett.com

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