NHERI Users Workshops
May 2018

Engineering for Civil Infrastructure (ECI)

Richard Fragaszy, Grace Hsuan, Joy Pauschke
(Program Directors)

Directorate for Engineering
Division of Civil, Mechanical and Manufacturing Innovation (CMMI)
National Science Foundation

NSF Strategic Goals

- **Strategic Goal 1: Expand Knowledge in science, engineering, and learning**

  "to promote the progress of science"

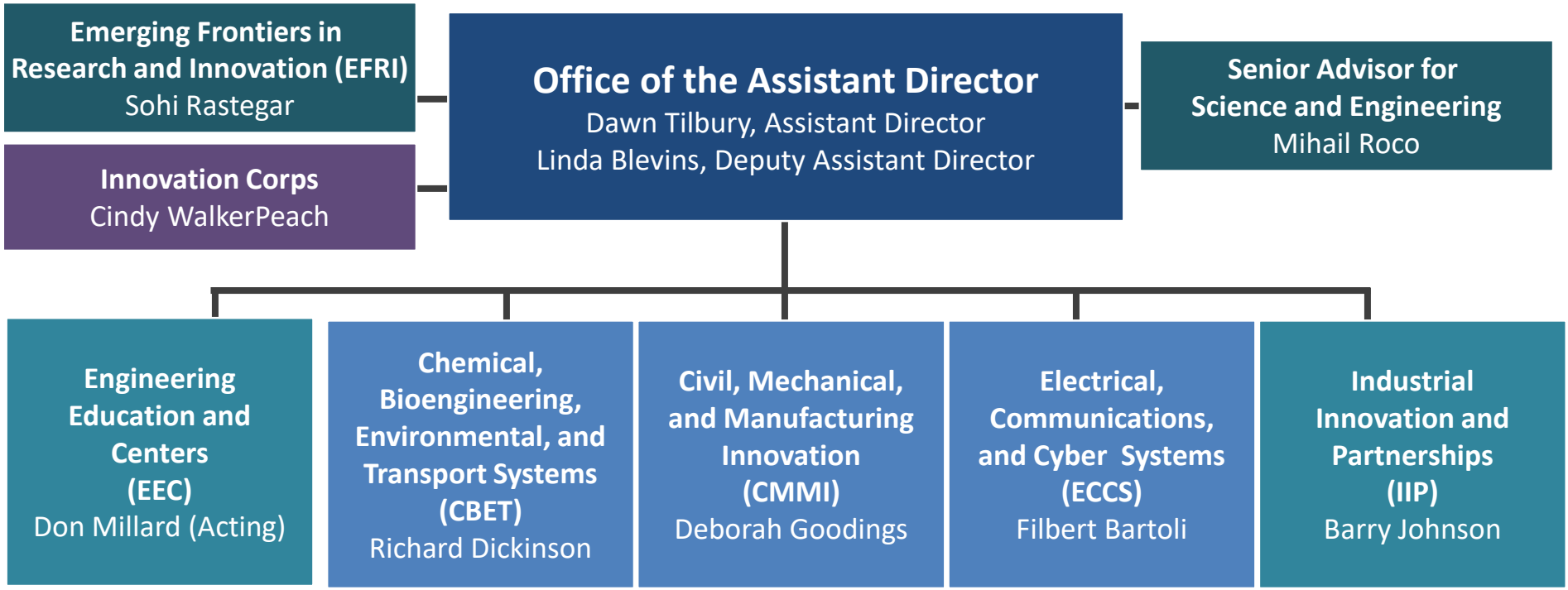
- **Strategic Goal 2: Advance the capability of the Nation to meet current and future challenges**

  "to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes"

What NSF Does

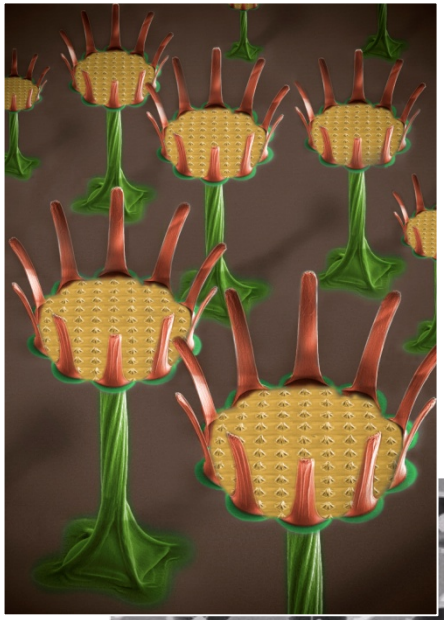
- Supports all fields of fundamental science and engineering, except for medical sciences.
- Ensures that research is integrated with education so that today's revolutionary work will also be training tomorrow's top scientists and engineers.

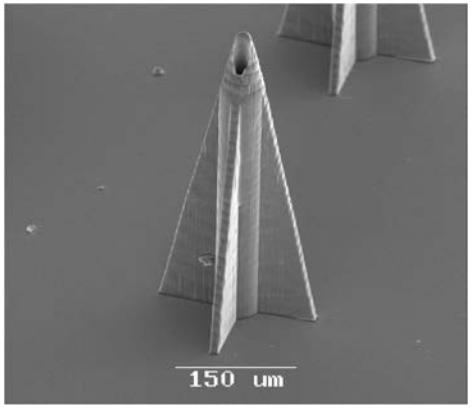
NSF Directorate for Engineering (ENG)

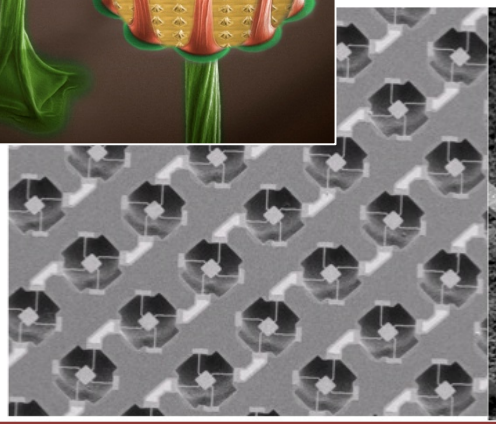


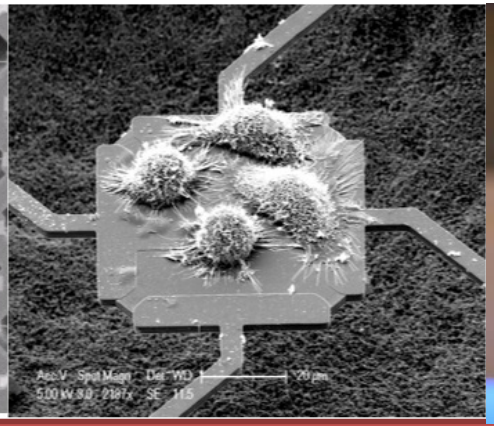
CMMI

Goal: Enabling the frontiers of research at all scales









Nanoscale to Infrastructure Scale Research

Division of Civil, Mechanical and Manufacturing Innovation (CMMI)

Division Director
Deborah Goodings
Deputy Director
Mary Toney

LEAP-HI
Bruce Kramer

Integrative Activities
J. Culbertson

Advanced Manufacturing

- Materials Engineering and Processing (MEP) *T. Kuech , A. Lewis*
- Manufacturing Machines and Equipment (MME) *Steve Schmid*
- Nano-Manufacturing (NM) *K. Cooper*
- Cybermanufacturing Systems *B. Kramer*

Mechanics and Engineering Materials

- Mechanics of Materials and Structures (MOMS) *K. Peters, Siddiq Qidwai*
- Biomechanics and Mechanobiology (BMMB) *D. Fyhrie*

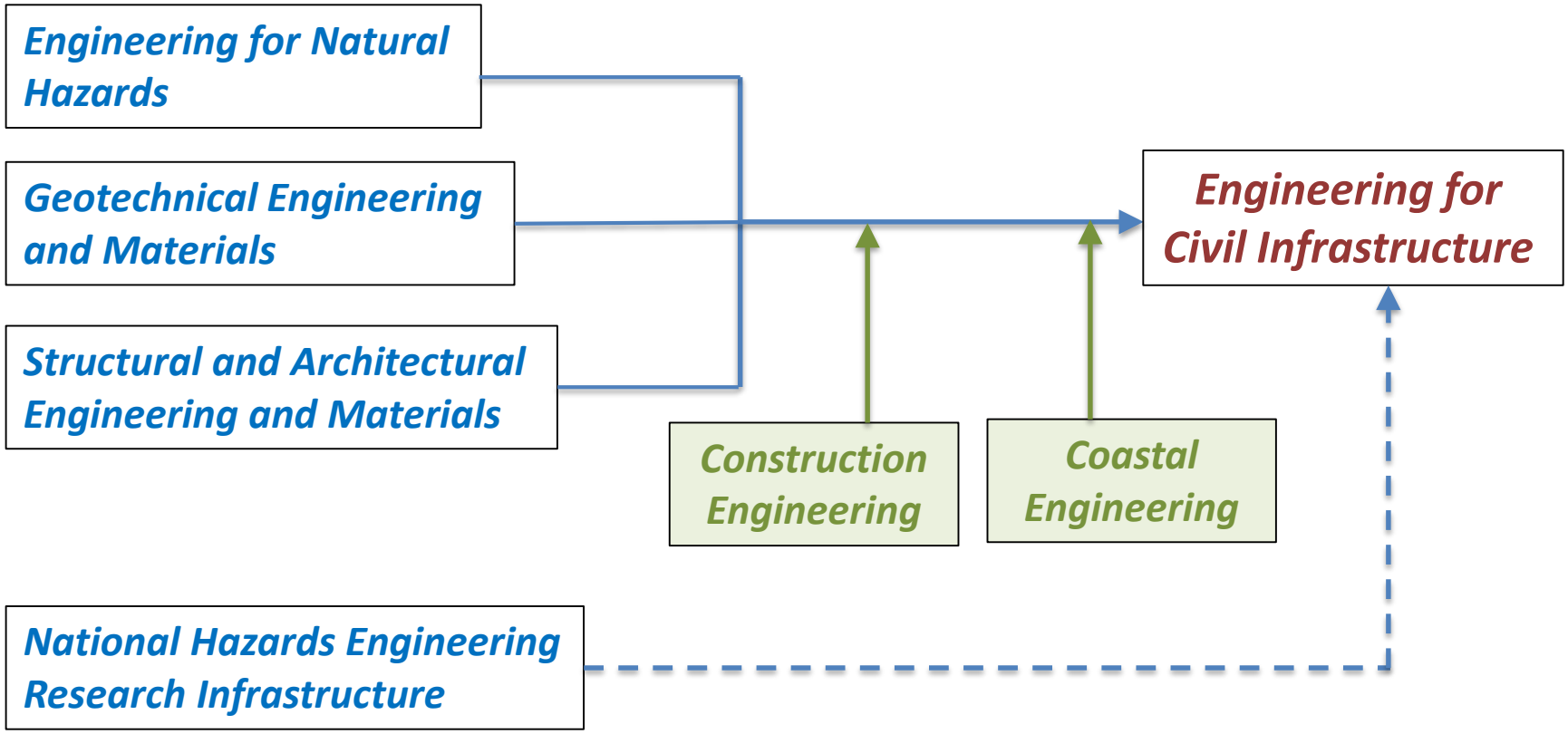
Resilient and Sustainable Infrastructures

- Civil Infrastructure Systems (CIS) *C. Chen*
- Engineering for Civil Infrastructure (ECI) *R. Fragaszy, Y. Hsuan, J. Pauschke*
- Humans, Disasters, and the Built Environment (HDBE) *R. Dillon-Merrill*
- Natural Hazards Engineering Research Infrastructure (NHERI) *J. Pauschke*

Operations, Design, & Dynamic Systems

- Engineering Design and Systems Engineering (EDSE) *R. Malak*
- Dynamics, Control and System Diagnostics (DCSD) *J. Berg, A. Kelkar*
- Operations Engineering (OE) *G. Klutke*
- Mind, Machine, Motor Nexus (M3X) *R. Scheidt*

Engineering for Civil Infrastructure (ECI)



Engineering for Civil Infrastructure (ECI)

ECI Program Description (a "dynamic" entity)

- https://nsf.gov/funding/pgm_summ.jsp?pims_id=505488
- Check before proposal writing/submission as description may change

ECI Program Directors:

- **Richard Fragaszy** (*Geotechnical and coastal engineering*)
- **Y. Grace Hsuan** (*Structural engineering-non-hazards, materials, and construction*)
- **Joy Pauschke** (*Structural engineering-hazards*)

The ECI Program

- Represents a new and integrated vision for fundamental research to underpin transformative innovations for the built environment.
- Focuses on the physical infrastructure, such as the soil-foundation-structure-envelope-nonstructural building system.
- Seeks proposals that advance knowledge and methodologies within geotechnical, structural, architectural, materials, coastal, and construction engineering.

ECI: Scope

The program supports fundamental research in:

- Shaping the nation's constructed civil infrastructure, subjected to and interacting with the natural environment and meeting the needs of humans
- Rethinking of traditional civil infrastructure in response to emerging technological innovations, changing population demographics, and evolving societal needs

ECI: Research Emphases

- Holistic building systems that view construction, geotechnical, structural, and architectural design as an integrated system;
- Adaptive building envelope systems;
- Nonconventional building materials;
- Breakthroughs in remediated geological materials and approaches;
- Bio-inspired and bio-mediated solutions; and
- Transformational construction processes commensurate with new visions for civil infrastructure.

Continued

- Civil infrastructure subjected to and interacting with the natural environment under:
  - normal operating conditions
  - intermediate stress conditions (including chemical and physical deterioration, cyclic loading, and severe locational and climate conditions)
  - extreme single or multi natural hazard events (earthquakes, windstorms, tsunamis, storm surges, sinkholes, subsidence, and landslides)

Continued

- Construction Engineering:
  - Integrating emerging technologies to revolutionize the construction process to be compatible with new visions for civil infrastructure (such as additive manufacturing, robotic fabrication, human-robot interactions, etc.)
- Coastal Engineering:
  - Challenges in the changing natural environment impacting civil infrastructure

Natural Hazards Engineering Research Infrastructure (NHERI) Facilities

<https://www.designsafe-ci.org>

Projects involve impact of natural hazards on civil infrastructure

- PIs are encouraged to leverage the research facilities of NHERI for proposals submitted to ECI or any other NSF program.

- PIs are also urged to fully utilize the NHERI Cyberinfrastructure and NHERI Computational Modeling and Simulation Center for using and sharing experimental and simulation data, computational models, and simulation tools (e.g., Data Management Plans).

NHERI Facilities

Component	Institution	NSF Award
Network Coordination Office	Purdue University	1612144
Cyberinfrastructure	University of Texas at Austin	1520817
Computational Modeling and Simulation Center	University of California, Berkeley	1612843
Twelve-Fan Wall of Wind	Florida International University	1520853
Large-Scale, Multi-Directional, Hybrid Simulation Testing Capabilities	Lehigh University	1520765
Large Wave Flume and Directional Wave Basin	Oregon State University	1519679
Geotechnical Centrifuges	University of California, Davis	1520581
Large, High-Performance Outdoor Shake Table	University of California, San Diego	1520904
Boundary Layer Wind Tunnel, Wind Load and Dynamic Flow Simulators, and Pressure Loading Actuators	University of Florida	1520843
Large, Mobile Dynamic Shakers for Field Testing	University of Texas at Austin	1520808
Post-Disaster, Rapid Response Research (RAPID) Facility	University of Washington	1611820

Collaborative activities encouraged

- Multidisciplinary and Interdisciplinary projects to impact transformation on architecture, structural design, construction process, and robotics.
- Collaboration with researchers in other engineering and science fields

  (e.g., biology, chemistry, physics, materials science, robotics, data science, advanced computation, additive manufacturing, etc.)
- International collaborations.
- Leadership, team work and communications that strengthen the research plan.

Research Topics not Supported by ECI

- Research on mission agency responsibilities:
  - Nuclear power plants (e.g., foundations, design, materials)
  - Energy-related infrastructures (e.g., wind farms; offshore drilling platforms; power and transmission lines, including towers)
  - Transportation infrastructure (e.g., bridges, roadways, pavements, waterways)
- Hazard characterization for and hazard mitigation of impact of explosions, fire, blast loading, flooding, and solar wind and storms
- Sensor and measurement technologies
  - Advancing imaging techniques and diagnostics, remote sensing techniques
- Field instrumentation and monitoring
- Induced seismicity
- Construction safety

Leading Engineering for America's Prosperity, Health, and Infrastructure (LEAP-HI)

Solicitation NSF 17-602

https://www.nsf.gov/pubs/2017/nsf17602/nsf17602.htm?WT.mc_id=USNSF_179

Program Director: Bruce Kramer

Letter of Intent Due Dates

July 16, 2018 and
July 15, Annually thereafter

Full Proposal Due Date

September 1-17, 2018, and
September 1-15, Annually thereafter

LEAP-HI Research Emphases

- Fundamental research that can lead to:
  - Disruptive technologies and methods
  - Lay the foundation for new and strengthened industries
  - Enable notable improvements in quality of life
  - Reimagine and revitalize the built environment

NSF Supports Fundamental Research

We look for proposals that

- Are visionary, innovative, push the frontiers of knowledge…
- Contribute to national needs and priorities
- Go beyond marginalia
- Integrate research and educational goals well
- Actually involve research, not development

We do not support (except as incidental to the research goals of the award)

- Developmental efforts
- Computer programming
- Design of…
- Commercialization

What is Research?

- Research is the *process* of finding out something that we (everyone) don't already know
- Scientific research builds upon the extant knowledge base and it is methodical, repeatable and verifiable
  - Methodical - you can specify in advance of the research a method to accomplish your objective
  - Repeatable - not a "strange" (random) event
  - Verifiable - tangible evidence
- Research results in knowledge

A Well Conceived Proposal

- *Contains four elements*:
  1. *A clearly stated research objective*
  2. *A well thought out plan to accomplish the stated research objective*
  3. *A convincing argument that the PI(s) can competently carry out the plan*
  4. *A convincing argument that the research is worth doing (Intellectual Merit, Broader Impact)*

- *The research objective appears to be the hardest part*
  - *Proposals with developmental objectives almost always review poorly*

Steps Towards Successful Proposal

- The **research goal** is to obtain a fundamental understanding of …
- The **research objective** is to test the hypothesis …
- Winning proposal needs both a research objective and **a plan** to accomplish the objective
- Finding the right NSF program for a proposal depends on the research objective

Continue

- Begin with
  - **White paper**, i.e., 1-2 page summary
  - **Dialog** with program officer
- Be an NSF **proposal reviewer—**best place to learn about what makes a winning proposal!
- Read the **solicitation** for requirements!
- **Collegial criticism**—you will find that what is clear to you is not clear to others … at all!

Funding Mechanisms

- Core/Unsolicited
  - Individual/small collaborative teams
- Solicitations
  - Special research call – DMREF, NRI, SNM
  - Early Career – CAREER
  - Instrumentation – MRI
  - Centers – ERC, STC
  - Small Business Innovation - SBIR, STTR
- EAGER and RAPID (must talk with Program Officer)
- Dear Colleague Letter (DCL)
- International Collaborations
- Workshops/Conferences

Looking Ahead: Ten Big Ideas

Navigating the New Arctic

Harnessing Data for 21st Century Science and Engineering

Work at the Human-Technology Frontier: Shaping the Future

RESEARCH IDEAS

Understanding the Rules of Life: Predicting Phenotype

The Quantum Leap: Leading the Next Quantum Revolution

Windows on the Universe: The Era of Multi-messenger Astrophysics

PROCESS IDEAS

Growing Convergent Research at NSF

NSF-Includes: Enhancing Science and Engineering through Diversity

Mid-scale Research Infrastructure

NSF 2050: Seeding Innovation

Temporary Program Director Rotator Position

- *Interagency personnel act (IPA)*
- *Visiting scientist, engineer, educator (VSEE)*
- *Duration of 2 to 4 years*

Current open positions:

- ***CMMI 2018-004 (PD for ECI)***
- ***CMMI 2018-003 (APD for MEP and MoMS programs)***

Finding the DCL documents:
CMMI web page → Additional Resources → Career Opportunities

Thank you

National Science Foundation

Alexandria, VA

(@Eisenhower Metro Stop – three stops from DCA Airport)