Computer and Information Science and Engineering (CISE)

Exploring the frontiers of computing

http://www.nsf.gov/dir/index.jsp?org=CISE

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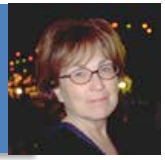


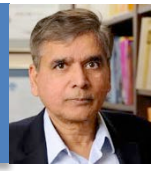
Advanced Cyberinfrastructure (ACI)

Irene Qualters, DD

- Data
- High Performance Computing
- Networking/ Cybersecurity
- Software

Computing and Communications Foundations (CCF)

Rao Kosaraju, DD



- Algorithmic Foundations
- Communication and Information Foundations
- Software and Hardware Foundations

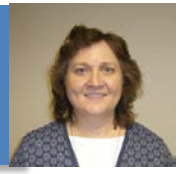
Computer and Network Systems (CNS)

Keith Marzullo, DD

- Computer Systems Research
- Networking Technology and Systems

Information and Intelligent Systems (IIS)

Lynne Parker, DD



- Cyber Human Systems
- Information Integration and Informatics
- Robust Intelligence

Advanced Cyberinfrastructure (ACI)

http://www.nsf.gov/div/index.jsp?div=ACI

Supports the acquisition, development, and provision of state-of-the-art cyberinfrastructure resources, tools, and services essential to the conduct of 21st century science and engineering research and education.

- *Data:* Support scientific communities in the sharing and archiving of, as well as computing with data by creating building blocks to address common community needs in data infrastructure.
- *High Performance Computing:* Enable petascale computing; provide open-science community with state-of-the-art HPC assets ranging from loosely coupled clusters to large scale instruments; develop an integrated scientific HPC environment.
- *Networking and Cybersecurity:* Invest in campus network improvements and re-engineering to support a range of activities in modern computational science. Support transition of cybersecurity research to practice.
- *Software:* Transform innovations in research and education into sustained software resources that are an integral part of cyberinfrastructure.

Computing & Communication Foundations (CCF)

http://www.nsf.gov/div/index.jsp?org=CCF

Supports research and education projects that explore the foundations of computing and communication devices.

- *Algorithmic Foundations (AF):* Innovative research characterized by algorithmic thinking and algorithm design, accompanied by rigorous mathematical analysis.
- *Communications and Information Foundations (CIF):* Transformative research addressing the theoretical underpinnings and current and future enabling technologies for information acquisition, transmission, and processing in communication and information networks.
- *Software and Hardware Foundations (SHF):* Foundational research essential to advance the capability of computing systems, including software and hardware components, systems, and other artifacts.

Computer and Network Systems (CNS)

http://www.nsf.gov/div/index.jsp?div=CNS

Supports research and education activities inventing new computing and networking technologies and exploring new ways to make use of existing technologies.

- *Computer Systems Research (CSR):* Transformative research on fundamental scientific and technological advances leading to the development of future generation computer systems, including new architectures; distributed real-time embedded devices; pervasive, ubiquitous and mobile computing; file and storage systems; operating systems; reliable, fault-tolerant and secure hard/middle/software.

- *Networking Technology and Systems (NeTS):* Transformative research on fundamental scientific and technological advances leading to the understanding, development, engineering, and management of future-generation, high-performance computer networks.

Information and Intelligent Systems (IIS)

http://www.nsf.gov/div/index.jsp?div=IIS

Supports research and education activities that study the inter-related roles of people, computers, and information.

- *Cyber-Human Systems (CHS):* Research to accelerate the creation and understanding of the complex and increasingly coupled relationships between humans and computing with the broad goal of advancing human capabilities: perceptual and cognitive, physical and virtual, social and societal.

- *Information Integration and Informatics (III):* Information technology research on the processes and technologies involved in creating, managing, visualizing, and understanding diverse digital content in circumstances ranging from individuals through groups, organizations, and societies, and from individual devices to globally-distributed systems, and that can transform all stages of the knowledge life cycle.

- *Robust Intelligence (RI):* Research that encompasses all aspects of the computational understanding and modeling of intelligence in complex, realistic contexts to advance and integrate the traditions of artificial intelligence, computer vision, human language research, robotics, machine learning, computational neuroscience, cognitive science, and related areas.

Critical Techniques and Technologies for Advancing Foundations and Applications of Big Data Science & Engineering (BIGDATA)

Developing techniques to manage and analyze data

- Two categories for submission:
  - Foundations: Encourages fundamental techniques, theories, methodologies and technologies of broad applicability.
  - Innovative Applications: Encourages novel techniques, methodologies, and technologies of interest to at least one specific application (special requirements).
- Awards: up to $500K per year for up to 4 year.
- Proposals due May 20, 2015.

Cross-Directorate Solicitation: CISE, BIO, EHR, ENG, and SBE

Cyberlearning and Future Learning Technologies

Improving learning by integrating emerging technologies with knowledge from research about how people learn

- Computer science is both the **enabling discipline** for the development of technologies that enhance learning and a discipline with an **immediate and critical need** for cyberlearning technologies as it aims to scale K-16 educational transformations at the national scale.

Research Thrusts:

- **Innovation**: Identifying new means of using technology for fostering and assessing learning;
- **Advancing understanding of how people learn in technology-rich learning environments**: Enhancing understanding of how people learn and how to better foster and assess learning; and
- **Promoting broad use and transferability of genres**: Extracting lessons from experiences with these technologies that can inform design and use.

Secure and Trustworthy Cyberspace (SaTC)

Securing our Nation's cyberspace

- Aims to support fundamental scientific advances and technologies to protect cyber-systems from malicious behavior, while preserving privacy and promoting usability.
- Proposals must address cybersecurity from one or more perspectives:
  - Trustworthy Computing Systems.
  - Social, Behavioral and Economic Sciences.
  - Secure, Trustworthy, Assured and Resilient Semiconductors and Systems (STARSS), jointly offered with the Semiconductor Research Corporation (special requirements).
  - Cybersecurity Education (special requirements).
- Transition to Practice option.

Project type	Submission window	Award size
Small	January 2-14 annually	up to $500,000 Up to 3 years
Medium	October 27 – November 10 September 2-19 annually thereafter	$500,001 to $1,200,000 Up to 4 years
Large	November 12-20 November 4-19 annually thereafter	$1,200,001 to $3,000,000 Up to 5 years
Cybersecurity Education	December 4-19 annually	Up to $300,000 Up to 2 years

Cyber-Physical Systems (CPS)

Deeply integrating computation, communication, and control into physical systems

- Aims to develop the core system science needed to engineer complex "smart" cyber-physical systems.
- Serves multiple key national priorities.
- Deadline: April 20 - May 4

Transportation

- Faster and safer aircraft
- Improved use of airspace
- Safer, more efficient cars

Energy and Industrial Automation

- Homes and offices that are more energy efficient and cheaper to operate
- Distributed micro-generation for the grid

Healthcare and Biomedical

- Increased use of effective in-home care
- More capable devices for diagnosis
- New internal and external prosthetics

Critical Infrastructure

- More reliable power grid
- Highways that allow denser traffic with increased safety

Project Types:

- **Breakthrough Projects**
  up to $500,000
  up to 3 years
- **Synergy Projects**
  $500,001 to $1,000,000
  over 3-4 years
- **Frontiers Projects**
  $1,000,001 to $7,000,000
  over 4-5 years

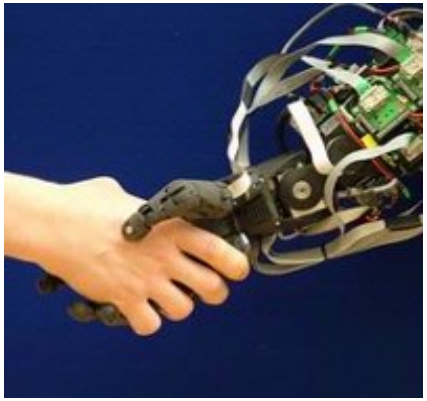
Cross-Directorate Solicitation: CISE and ENG

Multi-agency Commitment: NSF, DHS, DoT, NASA, and NIH

National Robotics Initiative (NRI)

Developing the next generation of collaborative robots to enhance personal safety, health, and productivity

- A nationally concerted cross-agency program to provide U.S. leadership in science and engineering research and education aimed at the development and use of cooperative robots that work alongside people across many sectors.
- Next deadline December 3, 2015



Credit: *Bristol Robotics Lab*

Research Thrusts

- **Fundamental research in robotics science & engineering**
- **Understanding the long term social, behavioral, and economic implications across all areas of human activity**
- **Use of robotics to facilitate and motivate STEM learning across the K-16 continuum**

Cross-Directorate Solicitation: CISE, EHR, ENG, and SBE

Multi-agency Commitment: NSF, DOD/DARPA, NASA, NIH, and USDA

Sample of Programs to Support CS Students, Teachers, and Early-Career Researchers

For a comprehensive list of CISE funding opportunities, visit:
http://www.nsf.gov/funding/pgm_list.jsp?org=CISE

- STEM + Computing (STEM+C) Partnerships

  Integrating computing into STEM
- NSF Research Traineeship (NRT)

  Preparing professionals in emerging STEM fields vital to the nation
- Computing Research Initiation Initiative (CRII)

  Enabling early research independence
- Faculty Early Career Development (CAREER) Program
- Graduate Research Fellowship Program (GRF)
- Research Experiences for Undergraduates (REU)

NSF Research Traineeship (NRT)

Preparing professionals in emerging STEM fields vital to the nation

Priority research theme: Data-enabled science and engineering

- Aims to create and promote new, innovative, effective, and scalable models for STEM graduate student training and prepare scientists and engineers of the future, particularly in emerging STEM fields vital to the nation.
- A new NSF graduate education initiative to replace the Integrated Graduate Research Traineeship (IGERT) program.
- Award tracks:
  - NRT Traineeship: up to $3M up to 5 years.
  - NRT Innovations in Graduate Education: $300K-$500K over 2-3 years.
- Proposal deadlines: May 6, 2015 and February 22, 2016

Computing Research Initiation Initiative (CRII)

Enabling early research independence

- Aims to contribute to the growth and development of future generations of scientists and engineers who will dedicate their careers to advancing CISE research and education.
- Provides the opportunity for individuals who are in their first academic position post-PhD to recruit and mentor their first graduate students.
  - Allows for a full budget for grad student salary only (and some travel, equipment) but no PI salary.
- Deadline: September 23, 2015 (Fourth Wed in Sept Annually)

Faculty Early Career Development (CAREER) Program

- The National Science Foundation's most prestigious awards in support of junior faculty who exemplify the role of teacher-scholars through:
  - outstanding research,
  - excellent education, and
  - the **integration of education and research** within the context of the mission of their organizations.
- Since its inception in 1996:
  - More than **200 programs** have reviewed CAREER proposals.
  - More than **7,000 awards**.
- PIs are allowed only one submission per competition.
- Deadline is typically in mid-July.

CISE CAREER Proposal Writing Workshops

- 2015 Workshop in Arlington, VA: March 16
- Presentations from March 2014 available at http://cs.gmu.edu/events/nsfcisecareer2014/

Support for Graduate and Undergraduate Students

- ***Graduate Research Fellowship Program (GRF)***
  - Foundation-wide programs with substantial CISE participation.
  - Deadlines in mid-Nov but differ for each Directorate.
- ***Research Experiences for Undergraduates (REU)***
  - **REU Sites**
    - Typically in summer.
    - 8-10 students in a cohort environment.
    - Deadline in August.
  - **REU Supplements**
    - Support for 1-2 students to work on existing project.
    - Best to submit request by March but no strict deadline.

Sample of CISE Cross-Cutting Programs

For a comprehensive list of CISE funding opportunities, visit:
http://www.nsf.gov/funding/pgm_list.jsp?org=CISE

- Cross-Division
  - Expeditions in Computing

    Exploring new frontiers in computing and information science

Expeditions-in-Computing

Exploring scientific frontiers that promise transformative innovations in computing

- Provides the CISE community an opportunity to pursue ambitious, fundamental research agendas that promise to define the future of computing and information.
- Successful projects bring together teams of investigators with diverse expertise within or across departments or institutions to identify compelling, transformative research agendas that seek disruptive innovations in CISE.

- ***Funding:***
  up to $2,000,000 per year
  for up to five years
- ***Limit:***
  1 Expeditions Proposal per individual
- ***Deadlines:***
  Preliminary Proposal (required): March 9, 2016
  Full Proposal: December 14, 2016


Image Credit: *Harvard University*

Expeditions-in-Computing

Beyond Moore's Law

- *The Molecular Programming Project*, CalTech, U Washington, 2008; & Harvard, UCSF, 2013
- *Variability-aware Software for Efficient Computing with Nanoscale Devices*, UCSD, UCLA, UIUC, Stanford, Michigan, 2010
- *Customizable Domain-Specific Computing*, UCLA, UCSB, Rice, Ohio State, 2009

Sustainability & Environment

- *Understanding Climate Change: A Data Driven Approach* – Minnesota, Northwestern, NC State, NC A&T State, 2010
- *Computational Sustainability: Computational Methods for a Sustainable Environment, Economy, and Society* – Cornell, Oregon State, Bowdoin, 2008

Wireless & Internet

- *Open Programmable Mobile Internet 2020,* Stanford, 2008

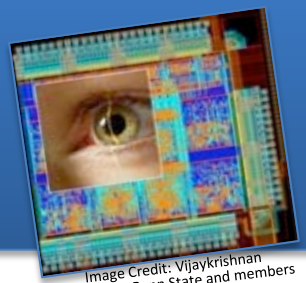


Image Credit: Vijaykrishnan Narayanan, Penn State and members of Visual Cortex on Silicon Team

Healthcare & Wellbeing

- *Socially Assistive Robots,* Yale, USC, MIT, Stanford, Willow Garage, 2011
- *Computational Behavioral Science: Modeling, Analysis, and Visualization of Social and Communicative Behavior,* Georgia Tech, MIT, Boston U, UIUC, USC, *Carnegie Mellon, 2010*

Robotics and Vision

- *Visual Cortex on Silicon*, Penn State, USC, Stanford, York College, UCSD, UCLA, Pitt, MIT, 2013
- *An Expedition in Computing for Compiling Printable Programmable Machines,* MIT, U Penn, Harvard, 2011
- *RoboBees: A Convergence of Body, Brain and Colony* – Harvard, Northeastern, 2009

Image Credit: Harvard University

Limits of Computation

- *Understanding, Coping with, and Benefiting from Intractability* – Princeton, Rutgers, NYU, Institute for Advanced Study, 2008

Image Credit: UC San Diego Jacobs School of Engineering

Formal Modeling and Verification

- *Expeditions in Computer Augmented Program Engineering,* U Penn, UC Berkeley, UMD, Rice, Cornell, U of Michigan, U of Illinois-UC, UCLA, MIT, 2011
- *Next-Generation Model Checking and Abstract Interpretation with a Focus on Embedded Control and Systems Biology,* Carnegie Mellon, Stony Brook, NYU, UMD, Pitt, Lehman College, JPL, 2009

Big Data

- *Algorithms, Machines, and People,* UC Berkeley, UC San Francisco, 2011
- *(Understanding Climate Change: A Data Driven Approach* – Minnesota, Northwestern, NC State, NC A&T State, 2010)

Image Credit: UC San Diego Jacobs School of Engineering

Other NSF-wide Opportunities for the CISE Community

- Innovation Corps (I-Corps)
- Grants for Rapid Response Research (RAPID)
- EArly-concept Grants for Exploratory Research (EAGER)
- Conferences, Summer Schools, and Workshops
- International Collaborations

For a comprehensive list of NSF funding opportunities, visit:
http://www.nsf.gov/funding/

RAPID and EAGER Proposals

- ***Grants for Rapid Response Research (RAPID)*:**
  - Supports quick-response research on natural or anthropogenic disasters and similar unanticipated events.
  - Up to $200K and one year duration.
  - Project descriptions are expected to be brief (two to five pages) and include clear statements as to why the proposed research is of an urgent nature.
- ***EArly-concept Grants for Exploratory Research (EAGER)*:**
  - Supports high-risk, exploratory and potentially transformative research.
  - Up to $300K and two years duration.
  - Project description is expected to be brief (five to eight pages) and include clear statements as to why this project is appropriate for EAGER funding.

Stay Informed

- Subscribe to get NSF updates by email at www.nsf.gov.
- Subscribe to receive special CISE announcements:
  - Send a message to: join-cise-announce@lists.nsf.gov with no text in the subject or message body.
- Visit the CISE website often: http://www.nsf.gov/dir/index.jsp?org=CISE.
- Talk to Program Directors: http://www.nsf.gov/staff/staff_list.jsp?org=CISE&from_org=CISE.
- Follow us on Twitter @NSF_CISE.

CISE Needs Good People

- Quality of program directors:
  - ✓ Affects quality of reviewers chosen for panels and ad hoc reviews.
  - ✓ Affects quality of reviews PIs receive.
  - ✓ Affects funding decisions.
  - ✓ Affects the nature and content of our research.
  - ✓ Affects the frontiers of our discipline.

Thanks!

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