



Computer and Information Science and Engineering

Exploring the frontiers of computing



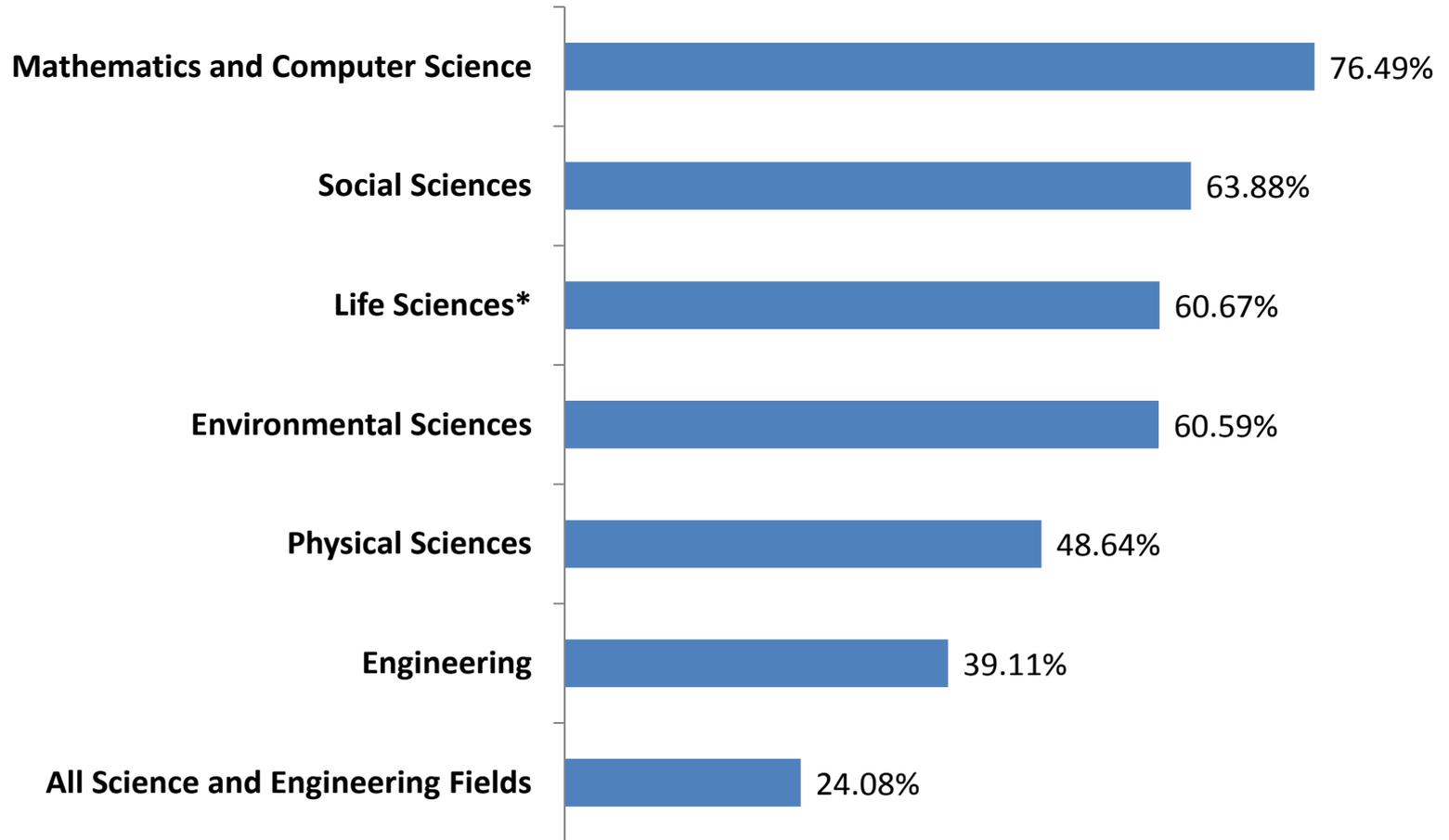
<http://www.nsf.gov/dir/index.jsp?org=CISE>

October 2012



NSF Support of Academic Basic Research in Selected Fields – FY 2009

(as a percentage of total federal support)



*Excludes the National Institutes of Health

Source: NSF Survey of Federal Funds for Research and Development



Goals of CISE Directorate

- To enable the U.S. to maintain a position of world leadership in computing, communications, and information science and engineering
- To promote understanding of the principles and uses of advanced computing, communications and information systems in service to society
- To contribute to universal, transparent and affordable participation in an information-based society



Overview of CISE Support

CISE Supports:

- Investigator-initiated **research** in all areas of computer and information science and engineering
- Cutting-edge national computing and information **infrastructure** for research and education
- **Education and training** of the next generation of computer scientists and engineers

Through:

- CISE Core programs
- CISE Cross-cutting programs
- NSF Cross-cutting programs



CISE Organization

Office of the Assistant Director for CISE
Assistant Director: Dr. Farnam Jahanian
Deputy Assistant Director: Dr. C. Suzanne Iacono

**Computing and
Communications
Foundations**

Division Director
Dr. Susanne Hambruch

**Computer and
Network
Systems**

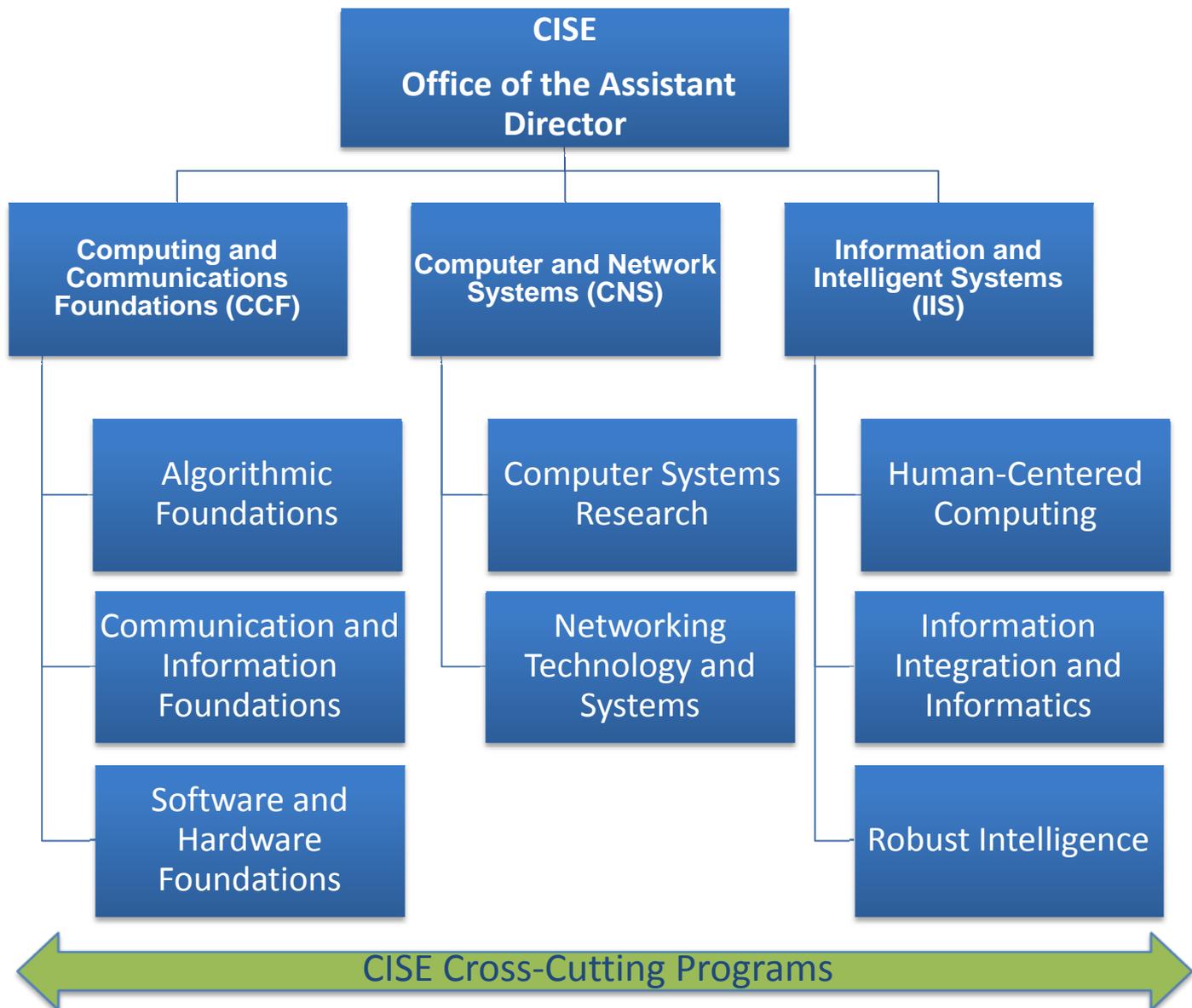
Division Director
Dr. Keith Marzullo

**Information and
Intelligent
Systems**

Division Director
Dr. Howard Wactlar



CISE Organization and Core Research Programs



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 and their usage.

- *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 that invent new computing and networking technologies and that explore 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 (e.g., new architectures; distributed real-time embedded devices; pervasive, ubiquitous and mobile computing; file and storage systems; new programming models, abstraction, languages, compilers, and 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.

- *Human Centered Computing (HCC)*: Research that explores creative ideas, novel theories, and innovative technologies that advance our understanding of the complex and increasingly coupled relationships between people and computing.
- *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.



Applying to Core Programs

- Program Solicitations:
 - CCF: [NSF 12-581](#)
 - CNS: [NSF 12-582](#)
 - IIS: [NSF 12-580](#)
- Project Types:
 - Large: \$1,200,001 to \$3,000,000; up to 5 years, collaborative teams
 - Medium: \$500,001 to \$1,200,000; up to 4 years, multi-investigator teams
 - Small: up to \$500,000; up to 3 years, one or two investigator projects
- CISE-wide Submission Windows:
 - Large: November 1 - 30, annually
 - Medium: September 15 – 30, annually (2013 and beyond)
 - Small: December 3 – 17, annually
- PI Limit:
 - Participate in no more than 2 “core” proposals/year

Coordinated
Solicitations

For a comprehensive list of CISE funding opportunities, visit:

http://www.nsf.gov/funding/pgm_list.jsp?org=CISE



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.
- **Cross-Directorate**
 - *Computing Education for the 21st Century (CE21)*
Engaging larger number and diversity of students and educators in computing education and learning.
 - *Cyberlearning: Transforming Education (CTE)*
Designing and implementing technologies to aid and understand learning.
 - *Cyber-Physical Systems (CPS)*
Integrating computation, communication, and control into physical systems.
 - *Enhancing Access to the Radio Spectrum (EARS)*
Enhancing access to wireless service and/or efficiency with which radio spectrum is used.
 - *Secure and Trustworthy Cyberspace (SaTC)*
Securing our Nation's cyberspace from malicious behavior, while preserving privacy and promoting usability.
 - *Smart Health and Wellbeing (SHB)*
Transforming healthcare knowledge and delivery, and improving quality of life through IT.
- **Cross-Agency**
 - *Core Techniques and Technologies for Advancing Big Data Science & Engineering (BIG DATA)*
Developing tools to manage and analyze data in order to extract knowledge from data.
 - *National Robotics Initiative (NRI)*
Developing and using robots that work alongside, or cooperatively with, people.



Expeditions-in-Computing

Exploring scientific frontiers that promise transformative innovations in computing

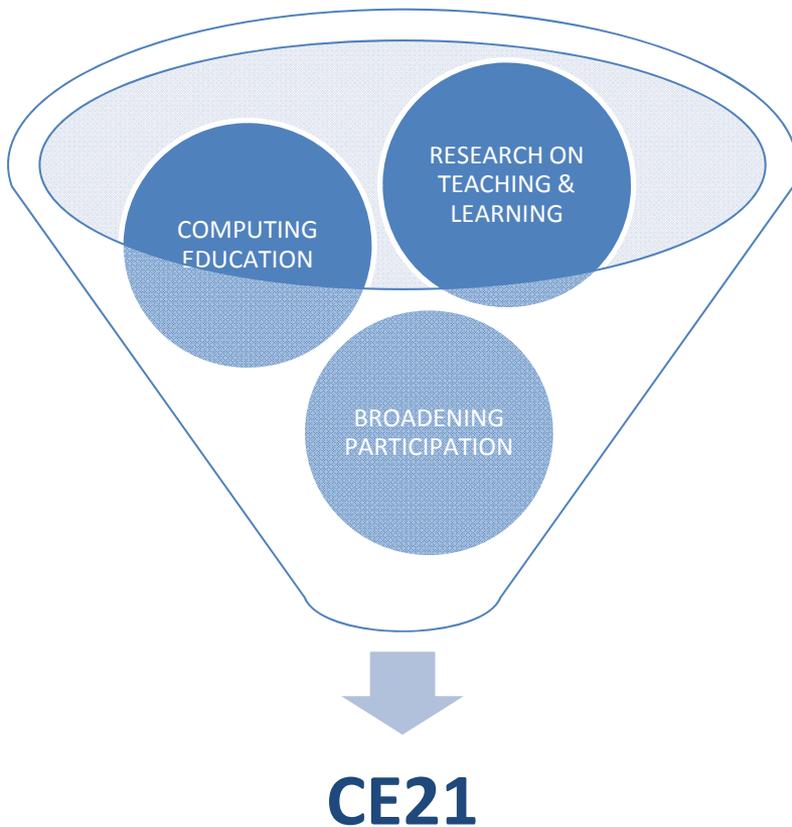
- Provides the CISE community an opportunity to pursue ambitious, fundamental research agendas that promise to define the future of computing and information .
- Successful projects bring together teams of investigators with diverse expertise within or across departments or institutions to identify compelling,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

- **Funding:**
up to \$2,000,000 per year
for five years
- **Limit:**
1 Expeditions Proposal per
Investigator
- **Deadlines:**
Preliminary Proposal (required): September 10, 2013
Full Proposal : May 10, 2014



Computing Education for the 21st Century (CE21)

Enhancing computational competencies



Goals:

- Increase number and diversity of K-14 students and teachers who develop and practice computational competencies.
- Increase number of postsecondary students who have background necessary to pursue degrees in computing and computationally-intensive fields.

Cross-Directorate Solicitation: CISE, EHR, OCI



Cyberlearning: Transforming Education

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

Goals:

- Design ways that innovative tools can be effectively integrated into learning,
- Understand how people learn with technology, and
- Implement new technologies into learning environments in ways so that their potential is fulfilled.



Image Credit: Georgia Computes! Georgia Tech

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.
- Coordinated across NSF and with other government agencies.
- Submission Window: January 14-19

Project Types:

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



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

Cross-Directorate Solicitation: CISE & ENG



Enhancing Access to the Radio Spectrum (EARS)

Enhancing access to wireless service and/or efficiency with which radio spectrum is used



Credit: Nicolle Rager Fuller, National Science Foundation

- Aims to strengthen U.S. leadership in the global wireless technology marketplace.
- Support for research in wireless communication, spectrum sharing, and mobile computing, as well as development of wireless and spectrum testbeds.
- Advance spectrum sensing techniques, explore machine learning and game theory for dynamic spectrum management, and understand incentive mechanisms.

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



Secure and Trustworthy Cyberspace (SaTC)

Securing our Nation's cyberspace

- Aims to support fundamental scientific advances and technologies to protect cyber-systems (including host machines, the Internet and other cyber-infrastructure) from malicious behavior, while preserving privacy and promoting usability.
- Proposals must address cybersecurity from one or more of three perspectives:
 - Trustworthy Computing Systems
 - Social, Behavioral and Economics
 - Transition to Practice
 - Cybersecurity Education (special requirements)



Image Credit: ThinkStock

Project Types:

- | | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none">• Small
Submission window:
early December
up to \$500,000
over 3 years | <ul style="list-style-type: none">• Medium
Submission window:
in 2012, early November
thereafter, late September
\$500,001 to \$1,200,000
over 4 years | <ul style="list-style-type: none">• Frontier
Submission window:
in 2012, late January
thereafter, early November
\$1,200,001 to \$10,000,000
over 5 years |
|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Cross-Directorate Solicitation: CISE, ENG, MPS, OCI, and SBE



Smart Health & Wellbeing (SHB)

Transforming healthcare knowledge, delivery, and quality of life through IT

- Address fundamental technical and scientific issues to support the transformation of healthcare from reactive and hospital-centered to preventive, proactive, evidence-based, person-centered and focused on wellbeing rather than disease.
- Must relate to a key health problem and must make a fundamental contribution to ENG, CISE, or SBE domains.
- New solicitation to be issued for FY 2013

Project Types:

- **Type I: Exploratory**
\$200,000 to \$600,000
over 2-3 years
- **Type II: Integrative**
\$600,001 to \$2,000,000
over 4-5 years

Research Thrusts

**Digital Health
Information
Infrastructure**

*Informatics and
Infrastructure*

**Data to Knowledge to
Decision**

*Reasoning under
uncertainty*

Empowered Individuals

*Energized, enabled,
educated*

**Sensors, Devices, and
Robotics**

Sensor-based actuation

Cross-Directorate Solicitation: CISE, ENG, and SBE



Core Techniques and Technologies for Advancing Big Data Science & Engineering (BIG DATA)

Foundational research to extract knowledge from data

- Foundational research for managing, analyzing, visualizing, and extracting useful information from large, diverse, distributed, and heterogeneous data sets.

Collection, Storage, and Management of "Big Data"

- Data representation, storage, and retrieval
- New parallel data architectures, including clouds
- Data management policies, including privacy and access
- Communication and storage devices with extreme capacities
- Sustainable economic models for access and preservation

Data Analytics

- Computational, mathematical, statistical, and algorithmic techniques for modeling high dimensional data
- Learning, inference, prediction, and knowledge discovery for large volumes of dynamic data sets
- Data mining to enable automated hypothesis generation, event correlation, and anomaly detection
- Information infusion of multiple data sources

Data Sharing and Collaboration

- Tools for distant data sharing, real time visualization, and software reuse of complex data sets
- Cross disciplinary information and knowledge sharing
- Remote operation and real time access to distant data sources and instruments

Cross-Directorate Program: NSF Wide

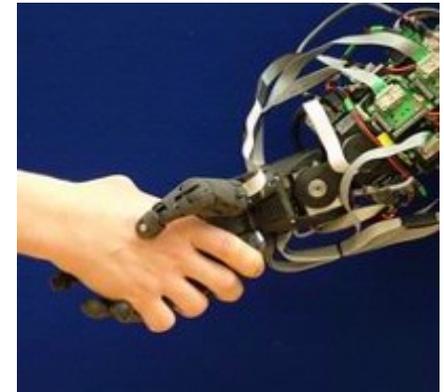
Multi-agency Commitment: NSF and NIH



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.
- Deadlines:
 - Small Projects: December 11, 2012 (In November thereafter)
 - Large Projects: January 23 (2013 and thereafter)



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, NASA, NIH, USDA



Innovation Corps (I-Corps)

Accelerating innovations from the laboratory to the market

- Aims to develop and nurture a national innovation ecosystem that builds upon fundamental research to guide the output of scientific discoveries to the development of technologies, products and processes that benefit society.
- Seeks to identify NSF-funded researchers to receive additional support - in the form of mentoring and funding.
- **Must consult with a program director before submission.**



Award Information:

- 25 awards in FY11
- 100 awards in FY12

NSF-wide Initiative



NSF-wide Opportunities for the CISE Community

- Faculty Early Career Development (CAREER)
- Grants for Rapid Response Research (RAPID)
- EARly-concept Grants for Exploratory Research (EAGER)
- Graduate Research Fellowship Program
- Research Experiences for Undergraduates (REU)
- Conferences, Summer Schools, and Workshops
- International Collaborations

For a comprehensive list of NSF funding opportunities, visit:

<http://www.nsf.gov/funding/>



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.

CISE CAREER Proposal Writing Workshops

- Temple University, Philadelphia, PA: March 15, 2013
- University of Texas at Arlington, Arlington, TX: May 17, 2013



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.
- **See Grant Proposal Guide (GPG) (NSF 11-1 before January 14, 2013 or NSF 13-1 on or after January 14) for more details.**



Support for Graduate and Undergraduate Students

- ***Graduate Research Fellowship Program***
 - 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, but not strictly necessary
 - 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



Conferences, Summer Schools, and Workshops

- ***Conferences***
 - Student Travel Support
 - Doctoral Consortia
- ***Summer Schools***
 - Intensive program for doctoral students on emerging research topics
 - Require faculty expertise not available at any single institution
- ***Workshops***
 - Bring the community together to reflect on, and identify emerging research opportunities and challenges

Must consult with a program director before submission.



International Collaborations

- ***Supplements*** to existing projects to allow US researchers to engage in collaborative activities with international partners:
 - True intellectual collaboration with foreign research partner
 - New international collaborations
 - Clear benefit to U.S. science/engineering community from expertise, facilities, or resources of the foreign collaborator; and
 - Active research engagement of U.S. students and junior researchers at the foreign site.
- ***East Asia and Pacific Summer Institutes for U.S. Graduate Students (EAPSI)***
- ***Pan-American Advanced Studies Institutes Program (PASI)***
- ***International Research Fellowship Program (IRFP)***
- If what you have in mind does not fit one of the existing programs, get in touch with the PD responsible for the country, or region of interest in the NSF Office of International Science and Engineering.



Commitment to Research and Education in CISE

- As a field of inquiry, computer, communication and information science and engineering has a **rich intellectual agenda** – highly creative, highly interactive, with enormous possibilities for changing the world!
- A thriving basic research community is the foundation for long-term **discovery** and **innovation**, **economic prosperity**, and **national security**.
- Our investments in **research and education** have returned exceptional dividends to our nation.
- **“To keep those benefits flowing, we need to constantly replenish the wellspring of new ideas and train new talent.” –Subra Suresh**



Stay informed and get involved!

- 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



Get NSF Updates
by Email



Opportunities for Community Engagement!

- Volunteer to be a reviewer.
- Visit NSF, get to know your program(s) and program director(s).
- Develop transformational ideas and send your best ideas to NSF.
- Participate in NSF-funded and hosted activities (e.g., workshops, COVs, ACs).
- Participate in the CCC/CRA visioning activities.
- Develop transitional ideas for how to move from ideas and prototypes to systems deployed on testbeds to technology transfer.
- Work within your institution to support and reward interdisciplinary research.
- Work within your institution to support service to the larger computing community around the globe.
- Send us your accomplishments; advertise your research to other citizens through local radio or TV, blogs, newspaper articles, etc.
- Join NSF to serve as program officers or division directors.



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!



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