

Robotics@NSF

Juan Wachs, Jprdan Berg.
Program Directors, CISE/ENG

FRR- NRI PI Meeting 2023 | May 3, 2023



Robotics@NSF

- **Foundational Research in Robotics (FRR)**
 - Program Description
 - Proposal Preparation and Proposal Handling
 - Categories & Budget Guidance
 - Unsolicited, CAREER, Research Initiation
 - International Partnerships
- **Robotics-Related Programs**



Robotics@NSF

- **Foundational Research in Robotics (FRR)**
 - Program Description
 - Proposal Preparation and Proposal Handling
 - Categories & Budget Guidance
 - Unsolicited, CAREER, Research Initiation
 - International Partnerships
- **Robotics-Related Programs**



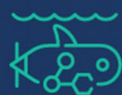
Foundational Research in Robotics (FRR)

- Core Program
 - Created in August 2020
 - Jointly managed by the Directorates for Engineering (ENG) and Computer and Information Science and Engineering (CISE)
 - All proposals are handled as part of a single unified program, irrespective of the division that initially receives the proposal
- **ENG**
 - CMMI –Jordan Berg, Siddiq Qidwai, Roni Barak Ventura, Kristin Calahan
 - ECCS –Tony Kuh
 - **CISE**
 - IIS –Juan P. Wachs, Cang Ye
 - CNS – David Corman, Ralph Wachter
 - CCF – Peter Brass



FRR: Broad Focus on Foundational Research

- The focus of the FRR program is on foundational advances in robotics
- Robotics is a deeply interdisciplinary field, and proposals are encouraged across the full range of fundamental engineering and computer science research challenges arising in robotics
- FRR supports research on robotic systems that exhibit significant levels of both computational capability and physical complexity



FRR: What is a Robot?

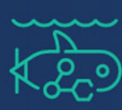
For the purposes of this program, a robot is defined as **intelligence** embodied in an **engineered construct**

- Here **intelligence** includes a broad class of methods that enable a robot to solve problems or to make contextually appropriate decisions and act upon them
- Here an **engineered construct** exhibits appropriate levels of physical complexity to enable the robot to sense and move within, or substantially alter, its working environment



FRR: Where should projects focus?

- Projects may focus on a distinct aspect of intelligence, computation, or embodiment
- Research is encouraged that considers inextricably interwoven questions of intelligence, computation, and embodiment
- Meaningful experimental validation on a physical platform is encouraged



FRR: What is responsive?

Is there a **robot**?

- The focus of the project should be a robot or a class of robots as defined in the program description

Will a robot gain a **new** or **significantly improved** capability?

- The goal of the project should be to endow a robot or a class of robots with new and useful capabilities or to significantly enhance existing capabilities

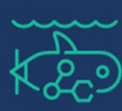
Is robotics **essential** to the *intellectual merit* of the proposal?

- The intellectual contribution of the proposed work should address fundamental gaps in robotics



FRR: Before submitting a proposal

- Potential investigators are strongly encouraged to discuss their projects with an FRR Program Officer before submission
- Send white paper (one page) to robotics@nsf.gov
 - Project overview
 - Intellectual merit
 - Broader impacts
 - Suitability for FRR (answers to the three questions)
- For any questions/clarifications: email robotics@nsf.gov



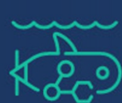
FRR: How are proposals handled?

- All proposals are handled as part of a single unified program, irrespective of the division that initially receives the proposal
- Submitted proposals are queued and paneled on a rolling basis
- Each panel is managed by two PDs: one from CISE and one from ENG
- Each panel consists of a mixture of reviewers with CISE and ENG backgrounds
- Panel outcomes are discussed by the entire FRR working group
- Recommendation decisions are made by the entire FRR working group
- Each awarded project has been co-funded by CISE and ENG



FRR: Categories

- Unsolicited Proposals (no deadlines)
- CAREER Proposals (deadline: Fourth Wednesday in July, Annually Thereafter)
- Research Initiation
 - CISE Research Initiation Initiative (CRII) (deadline: Sep 30, 2023)
 - Engineering Research Initiation (ERI) (deadline: Sep 15, 2023)



FRR: Categories : Unsolicited

- Unsolicited Proposals (no deadlines)

FRR Budget Guidelines & Project Durations

FRR does not have any explicit budget or duration limits, however the proposal must convincingly articulate that the requested budget is commensurate with the scope and potential contribution of the project

- Typical unsolicited projects are approximately \$150K-250K per year
- Typical unsolicited projects are 3-4 years in duration

FRR does not explicitly exclude proposals with higher budgets and/or up to 5-year duration



FRR: Categories : CAREER (July, 2023)

- General CAREER Webinar on April 22, 2022:
https://www.nsf.gov/news/news_summ.jsp?cntn_id=300464&org=NSF&from=news
- FRR CAREER Webinar on April 26, 2021:
<https://beta.nsf.gov/funding/opportunities/foundational-research-robotics-frr/announcements/robotics-webinar-career-pis>

FRR Budget Guidelines & Project Durations

- Duration is exactly 5 years
- Budget is between \$500,000 and \$600,000
- Typical budget includes support for a graduate student, PI (at least 15 days/year), travel, publications, and some materials



FRR: Categories : Research Initiation

CISE Research Initiation Initiative (CRII) [Sep 30, 2023 : \$175,000 for 2 years]

- CRII seeks to award grants intended to support research independence among early-career academicians who specifically lack access to adequate organizational or other resources
- The CRII program seeks to provide essential resources to enable early-career PIs to launch their research careers
- This funding opportunity also aims to broaden the engagement of investigators in CISE research and therefore is limited to investigators that are either
 1. Affiliated with an Institution of Higher Education that is not a “very high research activity” R1 institution or
 2. Non-profit non-academic institutions

Webinars:

July 13, 2022: 2:00pm-3:00pm EDT



FRR: Categories : Research Initiation

Engineering Research Initiation (ERI) [Sep 15, 2023 : \$200,000 for 2 years]

(ERI) program will support new investigators as they initiate their research programs and advance in their careers as researchers, educators, and innovators

This funding opportunity aims to broaden the base of investigators involved in engineering research and therefore is limited to investigators that are not affiliated with “very high research activity” R1 institutions

Webinars:

June 1, 2022: 2:00pm-3:00pm EDT

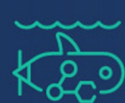
July 13, 2022: 2:00pm-3:00pm EDT

Sep 28, 2022: Engineering Research Initiation Program Q&A



FRR: International Partnerships

- NSF and U.S.-Israel Binational Science Foundation (BSF) (NSF 20-094)
- US-Ireland-Northern Ireland R&D Partnership (NSF 20-064)
- NSF Engineering - UKRI Engineering and Physical Sciences Research Council Lead Agency Opportunity (ENG-EP SRC) (NSF 20-510)
- NSF collaboration with Czech Science Foundation (GACR) (NSF 21-111)
- NSF and the Natural Sciences and Engineering Council of Canada (NSERC) Collaborative Research Opportunity (NSF 22-031)
- Joint U.S.-India funding opportunity (NSF 22-040)



Robotics-related programs

Advancing Informal STEM Learning (EHR/DRL/AISL)
Cyber-Physical Systems (CPS)
Disability and Rehabilitation Engineering (ENG/CBET/DARE)
Discovery Research PreK-12 (EHR/DRL/DRK-12)
Dynamics, Control and Systems Diagnostics (ENG/CMMI/DCSD)
Energy, Power, Control, and Networks (ENG/ECCS/EPCN)
Future of Work at the Human-Technology Frontier: Core Research (FW-HTF)
Human-Centered Computing (CISE/IIS/HCC)
Industry-University Cooperative Research Centers (IUCRC)
Innovation Corps (I-Corps) Teams Program (TIP)
Innovative Technology Experiences for Students and Teachers (EHR/DRL/ITEST)
Law and Science Program (SBE/SES/LS)
Mind, Machine and Motor Nexus (ENG/CMMI/M3X)
Partnerships for Innovation (TIP)
Perception, Action & Cognition (SBE/BCS/PAC)
Research on Emerging Technologies for Teaching and Learning (RETTL)
Robust Intelligence (CISE/IIS/RI)
Science and Technology Studies (SBE/SES/STS)
Science of Learning and Augmented Intelligence (SBE/BCS/SL)
Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) - America's Seed Fund
Smart and Connected Health (SCH)

Robotics@NSF

<https://www.nsf.gov/robotics>



Robotics-Related Programs

Smart and Connected Health (SCH)

SCH welcomes robotics related proposals that use established robotics techniques to accelerate the development and integration of innovative computer science and engineering approaches that would support the transformation of health and medicine. SCH does not fund proposals for assistive technology that addresses a person's quality of life, but not health per se.

Disability and Rehabilitation Engineering (ENG/CBET/DARE)

The DARE program supports fundamental engineering research that will improve the quality of life of persons with disabilities through the development of new technologies, devices, or software; advancement of knowledge regarding normal or pathological human motion; or understanding of injury mechanisms. DARE welcomes proposals where established robotic systems are used to contribute to the improved quality of life of persons with disabilities. Areas of particular interest are neuroengineering and rehabilitation robotics.



Robotics-Related Programs

Robust Intelligence (CISE/IIS/RI)

The Robust Intelligence (RI) program accepts research proposals aimed at contributing deeper understanding and new insights in and across the disciplinary areas outlined in the RI program description. The RI program no longer accepts proposals whose principal research focus is on robotics. Proposals to RI may involve robots as platforms for evaluation and demonstration of the applicability and broader impacts of RI claims. Proposals that focus primarily on the embodiment of intelligent systems should now be submitted to the FRR program

Human-Centered Computing (CISE/IIS/HCC)

Robotic-related proposals may be of interest to the HCC program if they focus on general contributions to human-technology interfaces rather than specifically on advances to human-robot interaction. HCC may also be more appropriate than the FRR program when investigators employ off-the-shelf robotic technology in order to study human behavior.



Robotics-Related Programs

CISE Community Research Infrastructure Program [Third Friday in July]

CCRI funds the development of CISE community infrastructure that enables research in CISE core disciplines. The infrastructure will enable CISE researchers to advance the frontiers of CISE research

- **Planning** – implement planning activities to develop a full CCRI proposal
 - max \$100K for 1.5 years
- **Medium** – develop community research infrastructure and user services
 - max \$2M/3 years [New or Enhance/Sustain (ENS)]
- **Grand** - develop significant new testbeds and platforms with associated user services and community engagement and outreach
 - max \$5M/5 years



Robotics-Related Programs

Cyber-Physical Systems (CPS)

The CPS program advances the science of engineered systems that are built from, and depend upon, the seamless integration of computation and physical components. Research proposals that advance the general science of CPS should be submitted to the CPS program, even if testing is on a robot or with a robotic system. Conversely, if a proposal is specific to a robot or class of robots, then the proposal should be submitted to the FRR program

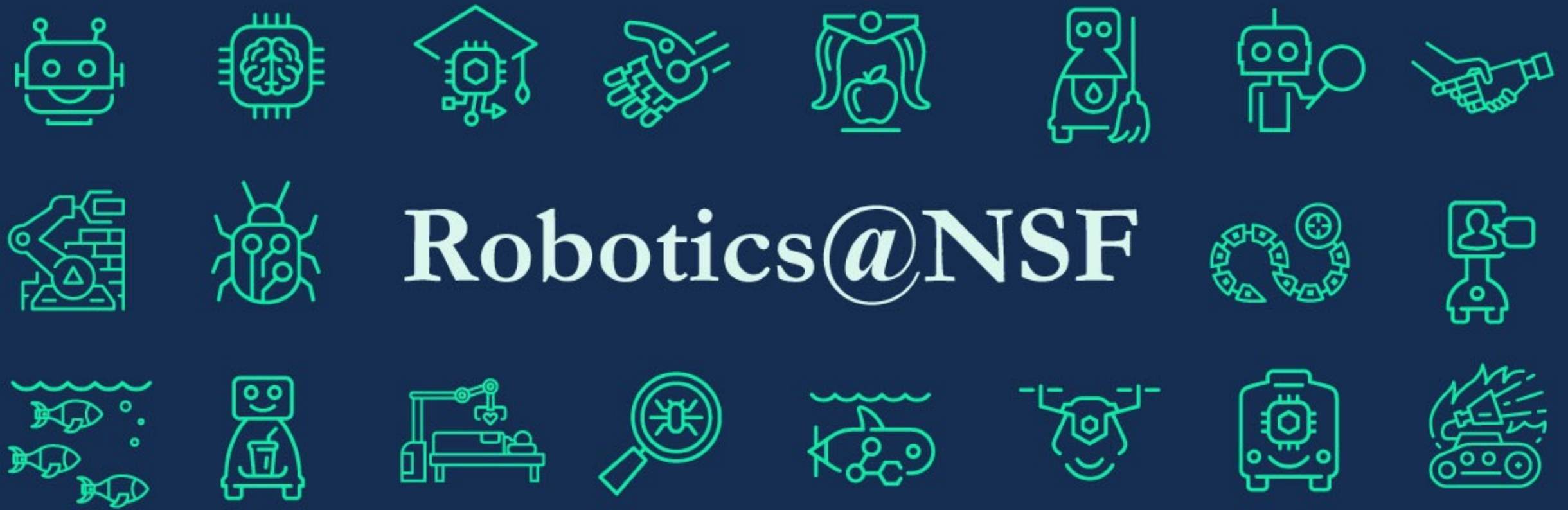
Dynamics, Control and Systems Diagnostics (ENG/CMMI/DCSD)

The DCSD program supports fundamental research in dynamics, including topics of modeling, analysis, diagnostics, and control. DCSD proposals must clearly articulate a primary intellectual contribution in at least one of these areas. DCSD may be an appropriate program if the proposed research objectives represent fundamental contributions to the field of dynamics and control, with robotics included primarily as a possible application area or validation platform.

Mind, Machine and Motor Nexus (ENG/CMMI/M3X)

The M3X program supports fundamental studies of bidirectional dynamic interactions between humans and intelligent machines. Interactions between humans and robots are within the scope of M3X, however the focus of an M3X project should be on emergent behavior arising from dynamic interactions, rather than on advances in robotic capabilities.





Robotics@NSF

Thank you!

robotics@nsf.gov



Robotics-Related Programs

Law and Science Program (SBE/SES/LS)

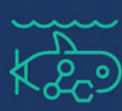
The LS program supports research that examines the key legal, regulatory, and ethical issues in respect to specific types of robotics and the role of governance in technological development. The program also welcomes research that examines the impact robotics will have on the law in areas such as data protection, consumer protection, and intellectual property, and the extent to which the legal system will adapt to changes brought about by robotic innovations.

Perception, Action & Cognition (SBE/BCS/PAC)

Robotic-related proposals may be of interest to the PAC program if they focus on discovering fundamental principles of human motor control and coordination, or perceptual or cognitive processes that might influence optimal design of robotic systems.

Research on Emerging Technologies for Teaching and Learning (RETTL)

The RETTL program funds exploratory research projects that advance robotics in support of learning. Areas of particular interest are social robots that engage conversationally and/or serve as an embodied partner with learners. Projects must advance both the learning sciences and robotics



Robotics-Related Programs

Advancing Informal STEM Learning (EHR/DRL/AISL)

The AISL program funds research and practice focused on the range of informal STEM learning experiences and environments that comprise life-long learning. As an NSF broadening participation emphasis program, AISL recognizes that an intentional and explicit strategy that advances equity is key to effectively building research and practice capacity in the informal STEM learning field. Proposals that explore robotics for learning/co-learning and engagement in informal contexts are welcome. Proposals that focus on learners with disabilities or adult audiences are of particular interest.

Discovery Research PreK-12 (EHR/DRL/DRK-12)

The DRK-12 program funds research and development projects related to formal STEM education. DRK-12 projects focused on robotics should promote student learning of STEM subjects in formal school or classroom spaces and/or teacher learning related to how to integrate robotics into STEM teaching and learning across the PreK-12 spectrum.

Innovative Technology Experiences for Students and Teachers (EHR/DRL/ITEST)

ITEST welcomes applied research and development proposals in which pre-K through 12th grade youth engage in innovative technology experiences, including experiences with robotics, in formal or informal settings. In ITEST projects, underrepresented or underserved youth participate in innovative technology experiences designed to ignite their interest in, and to prepare them for, the science, technology, engineering, and mathematics (STEM) workforce of the future.



Robotics-Related Programs

Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) - America's Seed Fund

America's Seed Fund helps startups and small businesses transform their ideas into marketable products and services, with focus on high-risk, high-impact technologies, including robotics, that show promise but whose success has not yet been validated.

Partnerships for Innovation (TIP)

The PFI program funds robotics related projects that will transition the technology out of the lab and into the market for societal benefit. Only NSF-funded research and researchers who either have a current NSF award or completed their NSF award in the last seven years or have participated in NSF Innovation Corps program in the last four years are eligible.



Robotics-Related Programs

Industry-University Cooperative Research Centers (IUCRC)

The IUCRC program accelerates the impact of basic research through close relationships between industry innovators, world-class academic teams, and government leaders. The IUCRC program spans a broad range of topics and supports a number of centers that include robotics-related context.

Innovation Corps (I-Corps) Teams Program (TIP)

Through the I-Corps Teams program, NSF seeks to spur translation of fundamental research to the marketplace, encourage collaboration between academia and industry, and train academic researchers in innovation and entrepreneurship skills. This includes support for teams developing robotics-related technologies that wish to accelerate the development of new technologies, products and processes that arise from fundamental research.

