National Robotics Initiative 2.0: Ubiquitous Collaborative Robots (NRI-2.0) NSF 17-518

Reid Simmons, CISE/IIS

National Science Foundation

Welcome

- **Jim Kurose** – Assistant Director
  Computer and Information Science and Engineering

- **Barry Johnson**– Acting Deputy Assistant Director
  Engineering Directorate

The NRI Team: NSF

- **CISE**: Reid Simmons (IIS), Ephraim Glinert (IIS), Tatiana Korelsky (IIS), Wendy Nilsen (IIS), Jie Yang (IIS), Daniel Hicks, (AAAS Fellow, IIS), Ralph Wachter (CNS), Jack Snoeyink (CCF)
- **ENG**: Radhakishan Baheti (ECCS), Jordan M. Berg (CMMI), Bruce Kramer, (CMMI)
- **SBE**: Fred Kronz (SES)
- **EHR**: David Haury (DRL)
- **OISE**: Seta Bogosyan

The NRI Team: Other Partner Agencies

- **USDA/NIFA**: Daniel Schmoldt, Steven Thomson
- **DOE**: Rodrigo Rimando
- **DOD**: David Han

- **NASA** & **NIH** are not participating in FY17

Outline

- Vision & Goals
- Research Themes & Agency Interests
- Programmatics
- Questions

Vision

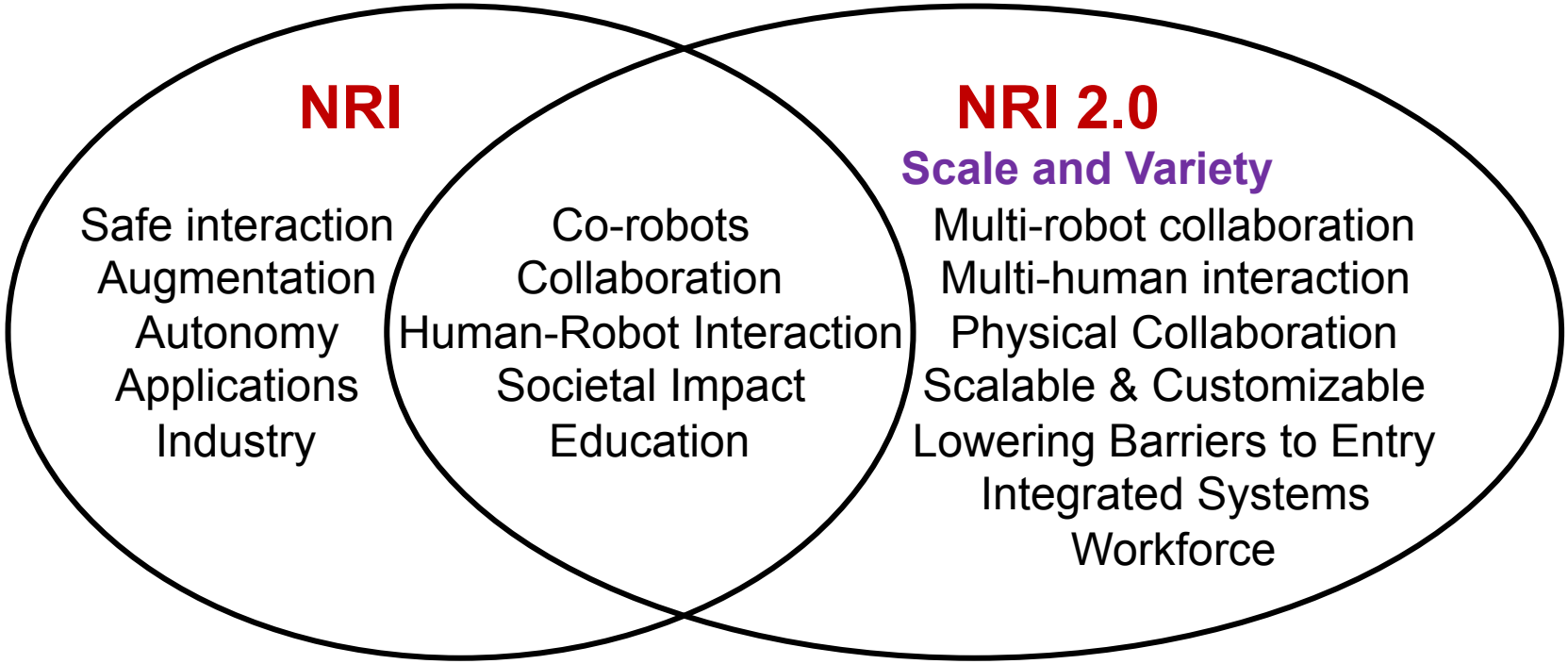
- **Ubiquitous Collaborative Robots**
  - Robots as commonplace as today's computers
  - Democratizing robotics: "Robots for all"
  - ***Scale*** and ***Variety*** of tasks
    (health, assistive, service, manufacturing, agriculture, environment, land, sea, air, space, education, …)
  - Enrich ***Quality of Life*** and ***Quality of Work***

Goals

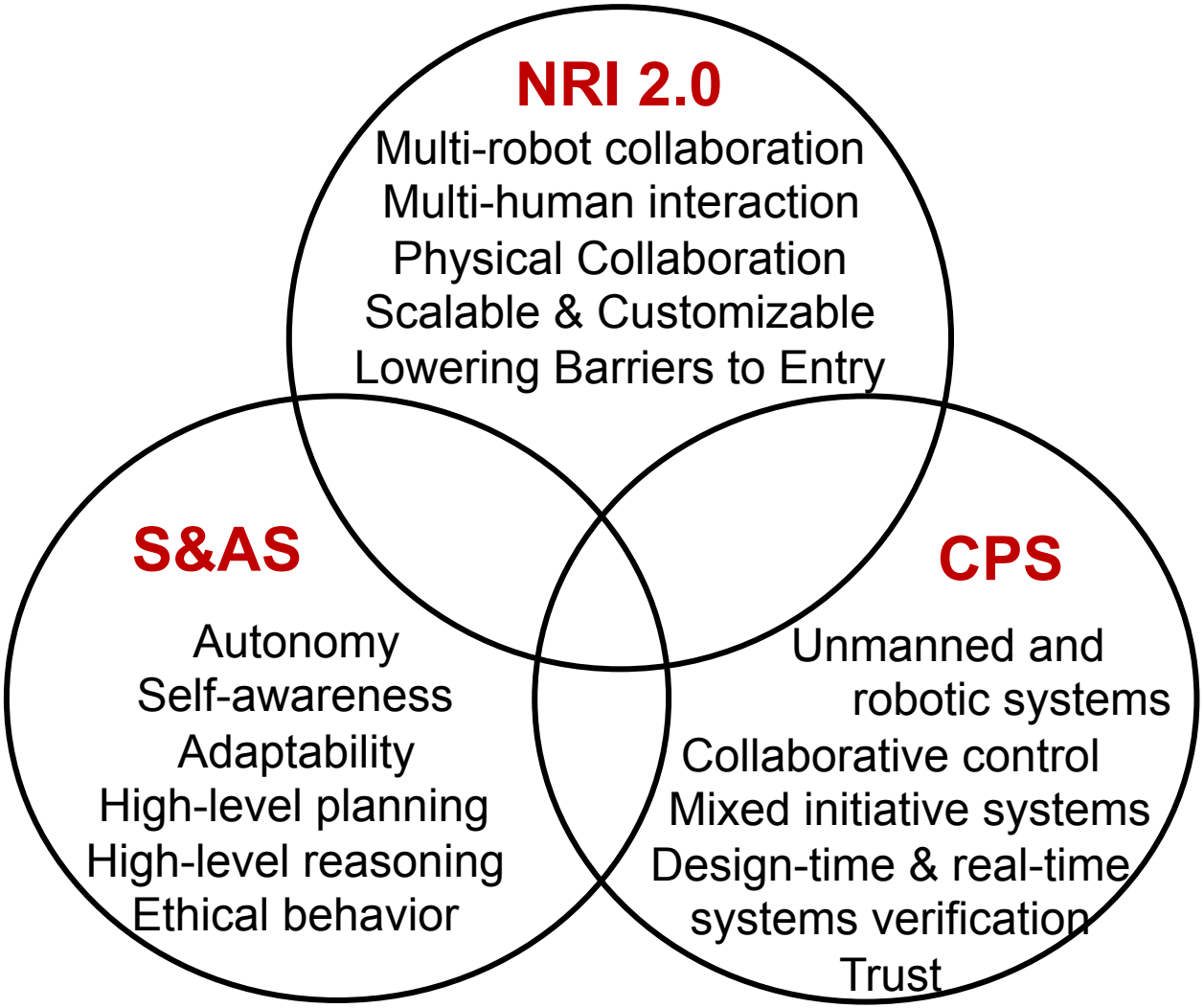
- **Ubiquitous Collaborative Robots**
  - Multi-robot, multi-human collaboration
  - Physical collaboration
  - Scalability
  - Customizability and Personalizability
  - Social, economic, legal, educational, workforce issues

- **Foundational technologies and integrated systems**

Relationships to NRI 1.0



Relationships to Other Programs



Research Themes

- **Collaboration**
- **Interaction**
- **Physical Embodiment**
- **Scalability**
- **Lowering Barriers to Entry**
- **Societal Impact**

Research Themes

- **Collaboration**
  - Robots working effectively with multiple other agents, both human and robots
  - Perceive, plan, and learn in a distributed fashion
  - Inform and instruct multiple other agents
- **Interaction**
  - Natural interaction with novices; Effective interaction with experts
  - Recognize and predict activities of others
  - Social intelligence, including use of mental models
  - Trust

Research Themes

- **Physical Embodiment**
  - Designs and materials for inherently safe co-robots
  - Physical collaboration
- **Scalability**
  - Easily customizable and personalizable robots
  - Managing large amounts of robot data
- **Lowering Barriers to Entry**
  - Robust, cost-effective, easy-to-use infrastructure
  - Techniques to enable shareable physical test beds

Social, Behavioral and Economic Sciences

- Topics or Research Themes
  - Within the workplace, what are the costs (such as loss of privacy, isolation, job loss) and benefits (such as workplace efficiency, economic growth and productivity, improved workplace quality) of co-robots?
  - Will interactions between humans and co-robots be determined by the societal conventions of communication, cooperation, and competition that hold between humans?
  - How will the ubiquity of co-robots change our understanding of what it means to be human? Will societies extend human rights to non-human agents based on value to society, or on interactions with human partners, or on some other basis?
- Funding Considerations
  - Foundational projects are more likely to be supported than Integrative projects (the two modes of support indicated in NSF 17-518)
- NRI Contact in SBE: Fred Kronz, fkronz@nsf.gov

Education and Human Resources

- Topics or Research Themes
  - Co-robotics in curricula and education research.
  - Advancement of the robotics workforce through education pathways.
- Funding Considerations
  - Potential to advance K-16 science, technology, engineering, and mathematics education.
  - Education-focused proposals are discouraged at the higher funding range.
- EHR Contact: David Haury, dhaury@nsf.gov

NSF Directorate for Engineering

- Research areas include
  - Control & Dynamics
  - Advanced Manufacturing
- Research topics of interest include
  - Physical embodiment
  - Scalability
  - Human-robot integration
- NSF/ENG Contacts
  - Kishan Baheti, rbaheti@nsf.gov
  - Jordan Berg, jberg@nsf.gov
  - Bruce Kramer, bkramer@nsf.gov

National Institute of Food & Agriculture

- Agency-Specific Research Themes
  - **Scalable Robotic Technologies** – automated systems to reduce costs/inputs or improve efficiency; robotics for controlled-environment or animal ag; post-harvest automation; and sensing systems for plant/animal products or natural resource mgmt.
  - **Configurable Multi-Agent Teams** - high-level task planning, execution, and control systems; inter-agent coordination and unsupervised collaboration; distributed intelligence with fault tolerance and "failure with grace"
- Agency-Specific Award Conditions
  - Proposals selected for funding require Grants.gov submission
  - Congressionally limited indirect costs (30% of total fed request)
  - NIFA does not fund collaborative projects (use subcontracts)
- NIFA awards (2012-2016) tinyurl.com/NRI-to-date
- NIFA contact: Steven.J.Thomson@nifa.usda.gov

DOE Interests

- Wearable robotic devices for workers
  - functioning as (1) smart personal protective equipment (PPE) and/or (2) performance augmentation and amplification devices (PAADs)
- Gaining remote access
  - to areas and spaces that are inaccessible or prohibit direct entry by workers
- Glovebox operations
  - The integration of robotic arms and hands that can be tele-operated by an operator/lab tech, for example, can offer increased ability, efficiency, capability, and safety.
- Multi-use, multi-user robotic technologies
  - dual-purpose robotic technologies that can be used to support normal as well as off-normal operations
- DOE contact: Rodrigo.Rimando@em.doe.gov

DOD Interests

- Effect of socially designed cues on team performance and human trust
- Effect of physical embodiment on team performance and human trust
- Dynamic modeling of human-robot collaboration
- Perception of human intent and internal states
- DOD contact: david.k.han@navy.mil

Project Classes

- **Foundational**:
  - Research fundamental techniques, theories, and technologies that contribute to the development of ubiquitous collaborative robots
  - Must focus on at least one of the research themes
- **Integrative**:
  - Research into novel integration of two, or more, of the research themes
  - Required to evaluate on physical robots, preferably in real-world settings
  - Multiple PIs, from different disciplines, are encouraged

Award Information

- Anticipated Funding of $30M-$45M in FY 2017
- Expected to award 40-70 projects
- **Foundational** Projects
  - $350K–$750K **total costs**; up to three years
- **Integrative** Projects
  - $500K–$1.5M **total costs**; up to four years

Note that budget ranges overlap – do not choose project class based on budget requirements

Review Criteria

- ***For All Projects:*** **Intellectual Merit**
- ***For All Projects:*** **Broader Impact**
- ***For All Projects:*** **Program Relevance**
  - Explicitly address the goal of achieving Intelligent Physical Systems that exhibit a high degree of autonomy
- ***For Integrative Projects***:
  - **Innovation** in the integration of the system
  - **Evaluation** plan, including testbed(s), proposed experiments, and evaluation metrics

Eligibility Requirements

- Universities and Colleges
  - Including community colleges
  - Accredited, and having a campus located, in the US
- Non-profit, non-academic organization
  - Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities
- At most two (2) NRI proposals for any PI, co-PI, or Senior Personnel in a given year

Proposal Submission

- Proposal deadline: February 2 , 2017 (due 5pm local time)
  - Refer to the solicitation
    - https://www.nsf.gov/pubs/2017/nsf17518/nsf17518.htm
    - Refer to “Proposal and Award Policies Procedures Guide”
    - https://www.nsf.gov/pubs/policydocs/pappguide/nsf16001
- Yearly PI meeting in the Washington, DC area
  - Account for travel in budget

Supplementary & Single Copy Documents

- Data Management Plan
- List of Project Personnel and Partner Institutions
  - List PIs, co-PIs, senior personnel, consultants, collaborators, subawardees, postdocs, advisory committee members
  - **Lead PI submits**
- Collaboration Plan
  - Any project with **more than one** (1) investigator
  - Length commensurate with complexity of project
- Postdoctoral Mentoring Plan (if applicable)
- Collaborators and Other Affiliations (COA)
  - Single copy document for ***each*** PI, co-PI, senior personnel
  - **Use Excel template at https://www.nsf.gov/cise/collab**

Thanks!

- Please send questions via email: NRI@nsf.gov
- Presentation will soon be made available on program website: https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503641