Institute for Connected-Sensors Systems (IConS)

Request for Proposals (RFP)
for
Collaborative Seed Research Projects in Sensors, Sensing, and Analytical Systems
(last updated: 06.21.2024)

Release Date: June 24, 2024

Submission Deadline: July 15, 2024

Contact Information: Dr. Michael Daniele (mdaniel6@ncsu.edu), Dr. Alper Bozkurt (aybozkur@ncsu.edu) and Dr. Veena Misra (vmisra@ncsu.edu)

I. Introduction

The Institute for Connected-Sensor Systems (IConS) invites proposals for collaborative seed research projects in the field of design, manufacturing and deployment of connected sensors, sensing, and analytical systems. This RFP seeks to foster interdisciplinary collaboration between a minimum of two different NC State colleges to collaboratively advance knowledge and innovation in this important area.

II. Background

Sensors and analytics play a crucial role in various fields such as healthcare, environmental monitoring, agriculture, manufacturing, and beyond. Collaborative research efforts in this domain can lead to breakthroughs with significant societal and economic impact. This RFP aims to encourage cross-college collaboration to explore new ideas, methodologies, and technologies in sensors, sensing, and analytical systems in application areas with societal impact and future external funding potential.

III. Objectives

The objectives of this RFP are to:

1. Foster collaboration between different colleges within NC State,
2. Promote innovative research in sensors, sensing, and analytical systems
3. Support the development of new interdisciplinary research teams,
4. Provide graduate students an opportunity to collaborate with researchers from other fields,
5. Generate preliminary results to enhance the potential for securing future external funding.

IConS looks forward to receiving innovative and collaborative proposals. These seed research projects are anticipated to lead to exciting discoveries and foster ongoing interdisciplinary partnerships within NC State University. This funding mechanism has a goal to advance the knowledge and innovation in design,

manufacturing and deployment of connected sensors, sensing, and analytical systems within the NC State ecosystem.

IV. Eligibility

Proposals must involve researchers from at least two different colleges within NC State. IConS encourages proposals from teams of junior faculty or those highlighting the synergies between junior and established faculty.
The collaborating colleges may include, but are not limited to, the following:

College of Agriculture and Life Sciences
College of Design
College of Education
College of Engineering
College of Humanities and Social Sciences
Poole College of Management (through MBA and STEM student engagement)
Wilson College of Textiles
College of Veterinary Medicine (through CBS program and F awards)

V. Funding & Cost Share Support

Each researcher will receive seed funding from their individual college for one graduate research assistant, including stipend, fringe, and tuition costs per project for the durations of August 15,2024 and June 30, 2025. For example, if a proposal involves two Colleges, two students (2×0.5 FTE) will be available for the project regardless of the number of co-PIs. Materials and supplies up to $3,000 will be supported by IConS via support from the Office of Research and Innovation.

It is anticipated that 2 to 4 projects will be funded through this RFP. The next RFP will be released 12 months later where researchers can apply for the next stage of project support or propose new sets of research topics. Every year the call will be accessible to the entire NC State research community.

VI. Proposal Topics

Connected Sensor-Systems are multi-node and multi-modal technologies, in which information from multiple sources can be combined and correlated to infer conclusions about manifest and latent problems, via real connection between nodes in a distributed network or combined in software to create a soft network. The predictive and actionable power of Connected Sensor-Systems will be realized by integrating novel sensors, advanced materials, low-power electronics, engineering, biochemistry, plant sciences, machine learning/artificial intelligence, design, and textiles, networking technologies and demonstration of performance at individual to global scale.

The future potential of external funding depends on the strength of the synergy emerging from an effective interdisciplinary collaboration and broadness of the societal impact the project is targeting. All NC State colleges contribute to excelling the knowledge to drive the next generation sensor development and its widespread connected deployment.

The cross-college collaboration is expected to bring an interdisciplinary synergistic perspective to advance not only the design, development, and deployment of connected sensor systems but its societal, educational and economic impact. The following provides some example interdisciplinary themes to help set up cross-college teams:
- Agriculture and Life Sciences: Using sensors to monitor plants, farms, animals, soil, and environmental conditions to improve crop yield.
- Design: Applying robust and sustainable design techniques to sensor systems to improve human factors, adoption, and impact

- Education: Training students in STEM for system design and data analytics through multimodal sensors and teaching the connected and quantified world to the next generations
- Engineering: Developing new sensors and algorithms through electrical, mechanical, chemical, optical, and acoustic engineering principles to enable intelligent sensing to action
- Humanities and Social Sciences: Using sensors to understand human behavior, social interactions and mental health, and the interaction in-between.
- Management: Supporting entrepreneurial activities involving smart sensor systems and data analytics based on these through the support of startups, case studies and business canvassing
- Natural Resources: Enabling sensor-driven quantitative understanding of our forests, coastal regions, soil, climate, and air quality and improving human interaction with parks/recreation.
- Sciences: Exploring the fundamental physical, chemical and biological sensing mechanisms at the macro, micro, and nano levels for enabling new sensor technologies
- Textiles: Transforming the textile industry through designing and manufacturing smart, sustainable, and active textiles that can help transform human conditions and the environment
- Veterinary Medicine: Using sensor data to help in maintaining animal health, achieve early detection of health problems, and assist in epidemiologic management of diseases in animals

Year 2 Seed Funding will focus on the following topics:
- Textile-based sensors can monitor environmental factors such as pollution levels, UV radiation exposure, and humidity, providing real-time data to users. These sensors can also be integrated into air filters to monitor their lifespan, in addition to providing feedback for controlling air quality. This initiative seeks interdisciplinary solutions to address major challenges in this field, including durability and reliability, integration complexity, scalability, cost, and environmental impact.
- Quantum sensing utilizes principles from quantum mechanics to achieve highly sensitive measurements of physico-chemical quantities. It has demonstrated promising capabilities in detecting minute changes in biomarkers associated with diseases at the molecular level. This initiative aims to integrate quantum sensing into real-world medical applications such as early detection of cancer or Alzheimer's disease. An interdisciplinary team must address several technical challenges, including sensitivity and specificity, biochemical interfaces, signal processing and data interpretation, miniaturization and integration, ethical considerations, regulatory compliance, validation, and socio-economic impact.
- Augmented Reality (AR) and Virtual Reality (VR) technologies hold significant promise for revolutionizing education through immersive learning experiences. Integrating these technologies with sensors in physical environments can significantly enhance engagement and interaction, benefiting both traditional classrooms and remote learning settings. This initiative seeks interdisciplinary teams to develop a seamless and effective AR/VR and sensor-based educational environment. Key challenges include multi-modal interaction design, real-time data integration, hardware compatibility and integration, pedagogical integration, user experience optimization, accessibility considerations, security and privacy measures, as well as ethical and policy considerations.
- Integrated Smart Infrastructure: The development and deployment of advanced sensor technologies are crucial for creating integrated smart infrastructure in both built and natural environments. In smart cities, sensors for traffic management and congestion monitoring, waste management optimization, and energy consumption monitoring in buildings significantly enhance urban efficiency and sustainability. Similarly, in industrial IoT (IIoT), predictive maintenance sensors for machinery, environmental sensors for hazardous condition monitoring, and supply chain management sensors for real-time tracking are essential for operational excellence. Home automation and security benefit from smart sensors for climate control, lighting, appliance management, intrusion detection, and early leak detection, which collectively enhance safety and convenience. In transportation and logistics, fleet management sensors, cold chain monitoring, and autonomous vehicle navigation sensors ensure efficient and reliable movement of goods and vehicles. Energy and utility sectors rely on smart grid sensors, renewable energy production monitoring, and pipeline sensors for optimal distribution and maintenance. Disaster management and response are bolstered by early warning sensors for natural disasters, structural health

monitoring for critical infrastructure, and search and rescue sensors, which are vital for safeguarding lives and property. Research topics suitable for proposals in this area include developing advanced algorithms for real-time data processing and predictive analytics to enhance the accuracy and responsiveness of sensor networks. Additionally, exploring novel sensor materials and designs to improve durability, sensitivity, and energy efficiency in harsh environments is also a critical area of research.

VII. Proposal Guidelines

Proposal Format: Proposals should adhere to the following format:
  - Title of the Project
  - Names and affiliations of Principal Investigators from each college
  - Abstract (250 words or less)
  - Project Description (not to exceed 2 pages excluding reference citations)

Applicants must include a dedicated section outlining how researchers from multiple different colleges will collaborate effectively on the proposed project. This section should address the following points:
- Describe the roles and responsibilities of each college in the project.
- Explain how the collaboration will facilitate interdisciplinary research.
- Detail the mechanisms for communication and coordination between the colleges.
- Highlight any existing or planned partnerships, joint initiatives, or shared resources that will support the collaboration.
- Outline the contribution of each researcher to the sensors field, whether they target design, development, manufacturing, deployment or use of sensors with a brief background about their expertise.
- The allocation of students between the PIs and co-mentorship strategy

Potential Funding Opportunities: Applicants should also discuss how the seed research project aligns with and may lead to potential external funding opportunities. Some potential opportunities are provided in the "Appendix". Please provide information on:
- Relevant funding agencies, grants, or programs that the project aligns with.
- A brief strategy for pursuing external funding based on the outcomes of the seed project.
- Any preliminary discussions or plans for grant applications or partnerships that may arise from the project.

These sections should be integrated into the Proposal Description and should not exceed the page limit.

Supplementary materials
- Deliverables and Timeline (not to exceed 1 page)
- References and bibliography
- Budget and budget justification
- Letter of support or email confirmation from all the PI's and co-PI's Deans or Associate Dean of Research's awareness and support of this proposal. The confirmation email or the letter should include the title of the proposal and mention the cross-college and interdisciplinary aspect of this effort. A short confirmation reply to an email sent by the PIs would fulfill this requirement. The point of contacts for each college is provided in the Appendix.

No Project Information and Navigation System (PINS) entry is required for this effort.

Review Criteria: Proposals will be evaluated based on the following criteria:
- Cross-college interdisciplinary collaboration
- Scientific merit and innovation
- Feasibility of the project
- Expected outcomes and impact
- Potential for future external funding

<u>Submission Deadline:</u> Proposals must be submitted electronically to Ren Shore (klshore@ncsu.edu) by **July 19, 2024 Friday 11:59pm EST**. Late submissions will not be considered.

VIII. Evaluation and Decision Timeline

- RFP Release Date: June 24, 2024
- Proposal Submission Deadline: July 19, 2024
- Review and Selection: August 2, 2024
- Award Notification: August 9, 2024
- Project Start Date: August 15, 2024

IX. Contact Information

Questions regarding this RFP should be directed to Dr. Michael Daniele (mdaniel6@ncsu.edu) and Dr. Alper Bozkurt (aybozkur@ncsu.edu) by July 19, 2024.

Appendix

College Point of Contacts for Letter of Support or Confirmation Email

College of Agriculture and Life Sciences
Dean Garey Fox   gafox2@ncsu.edu
Associate Dean Steven Lommel   slommel@ncsu.edu

College of Design
Dean Mark Hoversten   mehovers@ncsu.edu
Associate Dean Soolyeon Cho   soolyeon_cho@ncsu.edu

College of Education
Dean Paola Sztajn   psztajn@ncsu.edu
Associate Dean Hector Junco   hjunco@ncsu.edu
Associate Dean Karen Hollebrands   kfholleb@ncsu.edu

College of Engineering
Dean Jim Pfaendtner   wjpfaend@ncsu.edu
Associate Dean Peter Fedkiw   fedkiw@ncsu.edu

College of Humanities and Social Sciences
Dean Deanna Dannels   dpdannel@ncsu.edu
Associate Dean Tom Birkland   tom_birkland@ncsu.edu
Associate Dean Denis Provencher   dmproven@ncsu.edu

Poole COM
Dean Frank Buckless   buckless@ncsu.edu
Associate Dean Richard Warr   rswarr@ncsu.edu

Wilson College of Textiles
Dean David Hinks   dhinks@ncsu.edu
Associate Dean Xiangwu Zhang   xzhang13@ncsu.edu

College of Veterinary Medicine
Dean Kathryn Meurs   kate_meurs@ncsu.edu
Associate Dean Joshua Stern   jastern@ncsu.edu

Selected Examples of Future Potential Opportunities to Follow this Seed Grant Opportunity

- DOE Energy Frontier Research Centers (EFRCs) DOE EFRC
- NSF Convergence Accelerators - Tracks L and M NSF 23-590
- NSF Biosensing Unsolicited NSF Biosensing
- NSF Communications, Circuits, and Sensing-Systems Unsolicited NSF CCSS
- NSF Networking Technology and Systems NSF 23-561
- NSF Expeditions in Computing NSF 20-544
- NSF Electronic and Photonic Materials NSF 23-612
- NSF Regional Innovation Engines NSF RIE
- NSF Research Traineeship Program NSF 23-516
- NSF Synthesis Center for Understanding Organismal Resilience NSF 23-564
- NSF Experiential Learning for Emerging and Novel Technologies (ExLENT) NSF 23-507
- NSF Research on Innovative Technologies for Enhanced Learning (RITEL) NSF 23-624
- NSF Smart Health and Biomedical Research in the Era of Artificial Intelligence (SCH) NSF23-614
- NSF Smart and Connected Communities (S&CC) NSF 22-529
- NSF Infrastructure Innovation for Biological Research (Innovation) NSF 23-578
- NSF Cyber-Physical Systems (CPS) NSF 21-551
- NIH Catalyze: Product Definition – Device Prototype Design and Testing, Diagnostic Disease Target Identification and Assay Development, and Research Tool Development HL 23-013
- ARPA-H Resilient Extended Automatic Cell Therapies (REACT) REACT
- ONR BASIC RESEARCH FOR ELECTRO-OPTIC/INFRARED (EO/IR) SENSORS AND SENSOR PROCESSING N00014-24-S-BC01 N00014-24-S-BC01
- DARPA Microsystems Technology Office (MTO) Office-wide HR001122S0030
- MTEC Military Prototype Advancement Initiative MTEC-24-01-MPAI
- USDA Specialty Crop Research Initiative USDA SCRI
- USDA Agriculture and Food Research Initiative USDA AFRI