Phase I – Research Concept Papers

To prepare for the next round of NSF EPSCoR RII Track-1 funding, Maine EPSCoR is executing a formal proposal development process.

For Phase I, researchers from Maine are invited to submit a concept paper that describes a current research problem/need for the state that might be applicable for the next Maine NSF EPSCoR RII Track-1 project.

Note that the Track-1 grant is required to address a comprehensive, integrated, trans-disciplinary, statewide focus that creates a substantial academic research infrastructure and involves participants from colleges and universities throughout the state. It is not designed for individual, single institution, or small group faculty research.

INSTRUCTIONS:
Please fill in the template below, using standard NSF font size requirements. The allowable maximum is two pages. If you require additional space, you may delete unused lines in the Senior Personnel section, or blank lines in the document - please do not delete any other lines or instructions.

Sections:
1) Indicate the general focus area of the research that you are proposing (i.e., aquaculture, alternative energy, etc.).
2) Indicate the contact person for this concept.
3) Indicate potential key personnel who could be part of the effort to address this research concept.
4) Intellectual Merit – please provide a brief description in each of the sections, relating it to the research focus that you have identified as a current problem/need for Maine.
5) Broader Impacts – please provide a brief description in each of the sections.

Due by:	February 15, 2017
Submit to:	shane.moeykens@maine.edu (as pdf or Word doc)

By submitting this concept paper, Maine researchers are giving permission to post this document on the Maine EPSCoR website in order to encourage statewide discussions and potential collaborative engagement prior to the next phase of the RII Track-1 project development process.

Personnel from each submitted concept paper are encouraged to look over the other submitted concept papers for potential synergy, and to contact others as applicable.

For more information see: https://umaine.edu/epscor/track-1-rii-development-process/
https://www.nsf.gov/pubs/2016/nsf16557/nsf16557.htm

1) Proposed Research Focus:					
2) Primary Contact Person:					
Name:	**Institution:**	**Title:**	**Dept.**	**E-mail:**	**Phone:**
Bruce Maxwell	Colby College	Professor and Chair	CS	bmaxwell@colby.edu	2078595854
3) Suggested/Potential Key Senior Personnel:					
Name:	**Institution:**	**Title:**	**Dept.**	**E-mail:**	**Phone:**
Ying Li	Colby College	Asst. Professor	CS	yingli@colby.edu	
Caitrin Eaton	Colby College	Asst. Professor	CS		
Josh Martin	Colby College	Asst. Professor	Biology	jpmartin@colby.edu	
Eric Chown	Bowdoin College	Professor	CS		
Stephen Majercik	Bowdoin College	Assoc. Professor	CS		

4) Intellectual Merit: (the research focus)

A. *Need: a brief statement of the research problem/need to be addressed, and why it is urgent for Maine to address this problem/need now (how it is currently limiting the state's capacity/research competitiveness).*

Robotics is a rapidly expanding field, enabled by modern materials, lightweight motors, high density batteries, computer vision, and machine learning. Robots are now available for both consumer and business applications, including farming and mining, companies are exploring the possibilities offered by autonomous flying drones, and most car companies are targeting autonomous vehicles on the road by 2020. Many robot applications exist in rural areas--e.g. farming, transportation, and wildlife and wilderness monitoring--and Maine's aging population may benefit from personal assistant or safety robots in their homes. Given the extensive potential uses for robots in Maine, we need to build the state's capacity for teaching students about robotics and providing them with the education necessary to start up or participate in companies exploring relevant applications.

B. *Research Goal & Objectives: describe the overall project goal to address this problem/need, and 1-3 key research objectives.*

The overall goal is to build a cohort of robotics-related faculty and research projects, with the goal of expanding this cohort across multiple institutions. Specific research objectives include.

1. Studying how to improve human-robot interaction and robot decision-making in social situations, with a particular focus on the concepts of trust, cooperation, and affective emotion.
2. Modeling, building, and controlling dynamic robotic communication and sensor networks to ensure reliable communication and control.
3. Modeling, building, and controlling robots to mimic or model biological systems in order to either achieve better performance or to confirm models of biological and neurological systems.

C. *Research Actions: describe a few specific key research actions that could be implemented to meet the objectives. Feel free to withhold any information deemed sensitive, given this information will be shared with the community.*

The primary support would be for for summer research students and faculty, post-doc positions, and robot hardware.

1. Working with students to develop social robots and run experiments in real-life situations such as building tour-guides and remote avatars in order to analyze the effectiveness of different interaction strategies for building trust and enhancing the human-robot interface.

2. Working with students to explore the use of different strategies for communication between robotic sensor platforms for both test-bed (indoor) tasks and trial (outdoor) tasks such as aerial search.

3. Working with students to study sensor and control systems for making biologically accurate robots that can respond to stimuli in a realistic manner to both enable robots to solve specific tasks and potentially enhance the realism of human-robot interactions.

D. Priority: *indicate how this research would address NSF and state priorities in advancing the frontiers of knowledge and understanding (within a field and/or across different fields).*

Robotics is a key area of the NSF CISE IIS division, with the National Robotics Initiative 2.0 focused on ubiquitous collaborative robots. The three research objectives identified above: social robots, communication and control of swarms, and bio-mimetic robots all support the concepts of human-robot collaboration and enhancing productivity on challenging tasks.

5) Broader Impacts: (related to the research focus)

E. **Impacts**: *potential to benefit society and contribute to the achievement of specific, desired societal outcomes.*
Robotics has the potential to greatly increase productivity and safety in many applications, including farming, transportation, wildlife management, search and rescue, and personal assistant, health, or monitoring robots.

F. **Impacts**: *potential economic development as a result of this research.*
Potential for new companies as a result of students and faculty engaged in robotics research, and an expanded workforce capable of contributing to different areas of robotics.

G. **Impacts**: *potential for statewide workforce development in this research area (faculty, postdocs, graduate and undergraduate students, and the professional workforce).*
The proposal would directly support multiple faculty and potentially a small number of post-docs. It would expand and improve robotics education and research opportunities for undergraduates in CS and Biology at Colby and potentially other institutions. Faculty and students could also connect with K-12 institutions to encourage more students to enter this and related fields.

H. **Impacts**: *potential to provide infrastructure that grows the state's academic research and education capacity.*
Robotics research requires physical hardware (robots) as well as associated high-performance computing power for related machine-learning applications. These resources are broadly enabling across a wide variety of disciplines.