Cyber-Physical Systems (CPS) Program Solicitation 20-563

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**Cyber-Physical Systems (CPS)**
PROGRAM SOLICITATION
NSF 20-563
REPLACES DOCUMENT(S):
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National Science Foundation

Directorate for Computer and Information Science and Engineering
Division of Computer and Network Systems
Division of Computing and Communication Foundations
Division of Information and Intelligent Systems
Office of Advanced Cyberinfrastructure

Directorate for Engineering
Division of Civil, Mechanical and Manufacturing Innovation
Division of Electrical, Communications and Cyber Systems

Department of Homeland Security, Science & Technology Directorate
U.S. Department of Transportation, Federal Highway Administration

National Institutes of Health
National Institute of Biomedical Imaging and Bioengineering
National Cancer Institute

National Center for Advancing Translational Sciences
Office of Behavioral and Social Sciences Research
U.S. Dept. of Agriculture
National Institute of Food and Agriculture

**Full Proposal Deadline(s) (due by 5 p.m. submitter's local time):** December 02, 2020
First Wednesday in December, Annually Thereafter

**Frontier proposals**

**Submission Window Date(s) (due by 5 p.m. submitter's local time):** June 08, 2020 - June 22, 2020
Medium Proposals

IMPORTANT INFORMATION AND REVISION NOTES

Small proposals are not invited in FY 2020. For FY 2021 (beginning Oct. 1, 2020) and beyond, the CPS program anticipates going to a "no-deadline" submission for Small and Medium proposals.

Any proposal submitted in response to this solicitation should be submitted in accordance with the revised NSF Proposal & Award Policies & Procedures Guide (PAPPG) (NSF 20-1), which is effective for proposals submitted, or due, on or after June 1, 2020.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Cyber-Physical Systems (CPS)

Synopsis of Program:

Cyber-physical systems (CPS) are engineered systems that are built from, and depend upon, the seamless integration of computation and physical components. Advances in CPS will enable capability, adaptability, scalability, resiliency, safety, security, and usability that will expand the horizons of these critical systems. CPS technologies are transforming the way people interact with engineered systems, just as the Internet has transformed the way people interact with information. New, smart CPS drive innovation and competition in a range of application domains including agriculture, aeronautics, building design, civil infrastructure, energy, environmental quality, healthcare and personalized medicine, manufacturing, and transportation. CPS are becoming data-rich enabling new and higher degrees of automation and autonomy. Traditional ideas in CPS research are being challenged by new concepts emerging from artificial intelligence and machine learning. The integration of artificial intelligence with CPS especially for real-time operation creates new research opportunities with major societal implications.

While tremendous progress has been made in advancing CPS technologies, the demand for innovation across application domains is driving the need to accelerate fundamental research to keep pace. At the same time, the CPS program seeks to open new vistas for the research community to think beyond the usual cyber-physical paradigms and structures and propose creative ideas to address the myriad challenges of today's systems as well as those of the future that have not yet been designed or fielded.

The CPS program aims to develop the core research needed to engineer these complex CPS, some of which may also require dependable, high-confidence, or provable behaviors. Core research areas of the program include control, data
analytics, and machine learning—including real-time learning for control, autonomy, design, Internet of Things (IoT), mixed initiatives including human-in- or human-on-the-loop, networking, privacy, real-time systems, safety, security, and verification. By abstracting from the particulars of specific systems and application domains, the CPS program seeks to reveal cross-cutting, fundamental scientific and engineering principles that underpin the integration of cyber and physical elements across all application domains. The program additionally supports the development of methods, tools, and hardware and software components based upon these cross-cutting principles, along with validation of the principles via prototypes and testbeds. This program also fosters a research community that is committed to advancing education and outreach in CPS and accelerating the transition of CPS research into the real world.

All proposals must include the following as part of the Project Description:

- **A Research Description** that describes the technical rationale and technical approach of the CPS research, including the challenges that drive the research problem and how the research integrates cyber and physical components. This section must also describe how the research outcomes are translational to other application domains. Specifically, it must include:
  - A subsection titled "CPS Research Focus" which describes the cyber-physical system attributes of the challenge problem and clearly identifies the core CPS research areas addressed in which the novel and foundational research contributions are being made;
- **An Evaluation/Experimentation Plan** that describes how proposed concepts will be validated and outlines the metrics for success;
- **A Project Management and Collaboration Plan** that summarizes how the project team is ideally suited to realize the project goals and how the team will ensure effective collaboration; and
- **A Broader Impacts** section that describes how the research will be disseminated to a broad and diverse audience. This should go beyond traditional academic publications and includes education and outreach from the research team spanning multiple levels of engagement. Broader Impacts encompasses Broadening Participation in Computing (BPC) and Engineering (BPE).

In FY 2020, NSF is working closely with multiple agencies across the federal government, including the U.S. Department of Homeland Security (DHS) Science and Technology Directorate (S&T); the U.S. Department of Transportation (DOT) Federal Highway Administration (FHWA); several National Institutes of Health (NIH) institutes and centers including the National Institute of Biomedical Imaging and Bioengineering (NIBIB), National Cancer Institute (NCI), and National Center for Advancing Translational Sciences (NCATS); and the U.S. Department of Agriculture National Institute of Food and Agriculture (USDA NIFA, hereafter referred to as NIFA).

Proposals for three classes of research and education projects--differing in scope and goals--are supported through the CPS program:
- **Small** projects may request a total budget of up to $500,000 for a period of up to 3 years. They are well suited to emerging new and innovative ideas that may have high impact on the field of CPS. Note that Small projects are not accepted under this solicitation.

- **Medium** projects may request a total budget ranging from $500,001 to $1,200,000 for a period of up to 3 years. They are well suited to multi-disciplinary projects that accomplish clear goals requiring integrated perspectives spanning the disciplines.

- **Frontier** projects must address clearly identified critical CPS challenges that cannot be achieved by a set of smaller projects. Furthermore, Frontier projects should also look to push the boundaries of CPS well beyond today's systems and capabilities. Funding may be requested for a total of $1,200,001 to $7,000,000 for a period of 4 to 5 years. Note that the Frontier project deadline is different than that for Medium projects.

Please note, this solicitation includes windows for Medium and Frontier proposals. Small proposals are not invited in FY 2020. For FY 2021 (beginning Oct. 1, 2020) and beyond, the CPS program anticipates going to a "no-deadline" submission for Small and Medium proposals. Specific annual deadlines for Frontier proposals are anticipated to continue as noted in this solicitation.