



NATIONAL SCIENCE FOUNDATION
2415 Eisenhower Avenue
Alexandria, Virginia 22314

NSF 18-063

Dear Colleague Letter: Real-Time Learning and Decision-Making in Engineered Systems (Real-D)

April 11, 2018

Dear Colleagues:

Real-time learning and decision-making in engineering systems will play an increasingly critical role in modern engineering systems and infrastructures, including the smart grid, transportation and mobility, water distribution systems, healthcare logistics and delivery systems, advanced manufacturing, chemical and biological process systems, sensor networks, sustainable buildings, smart and connected communities, and dynamic control of transport processes. While complex engineering systems incorporate first principles based on physical models, they may not make full use of relevant information from real-time data. Exclusively data-driven approaches to complex engineering systems may lead to incorrect and uninformed decisions as they do not incorporate useful information from the engineering and physical models. A hybrid approach that uses real-time data, in conjunction with basic physical and engineering constraints, has the promise to overcome these limitations and can lead to significantly improved decision capabilities.

With this Dear Colleague letter (DCL), the Directorate for Engineering of the National Science Foundation announces its interest in receiving EARly-Concept Grants for Exploratory Research (EAGER) proposals to support research in fundamental theory, algorithms, engineering principles, and applications for real-time learning and decision-making that may lead the way toward safe, reliable, and efficient data-enabled engineering systems. To encourage convergence research, proposals are expected to have (PI)s that (has)have complementary expertise and significant research background in: the domain of the specific engineering infrastructure systems under consideration; and in machine learning, optimization, systems modeling and control and/or data science.

Examples of research topics include but are not limited to:

1. Theory, methods, and implementation of distributed real-time learning and decision-making with substantial improvement compared to other distributed real-time learning algorithms and traditional centralized processing.
2. Theory, development, and implementation of real-time learning of unlabeled data which could then be used together with a model-based approach, supervised learning algorithms, and/or anomaly detection methods.
3. Innovations in theory and methods that can exploit availability of data -- historical and real-time - to achieve higher fidelity dynamic models of complex high-order interconnected systems and to formulate advanced control strategies for such systems.

4. Innovative approaches for combining model-based and model-free approaches including evaluation of data trustworthiness and fairness, and methods for model validation.

EAGER proposals must follow NSF's Proposal & Award Policies & Procedures Guide (PAPPG) Chapter II.E.2: https://www.nsf.gov/pubs/policydocs/pappg18_1/pappg_2.jsp#II.E.2). This includes discussing the proposal with at least one of the program directors listed below well before submission, and establishing that the project satisfies the high-risk/high-return expectations for EAGERs. In addition, as stated above, proposals are expected from PIs with complementary and sufficient expertise. Proposals may then be submitted to the program of one of the program directors contacted, with the prefix "EAGER: Real-Time: [title]". Proposals will be evaluated as received. For consideration for funding in Fiscal Year 2018, proposals must be submitted by June 1, 2018.

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Sincerely,
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