Office of Emerging Frontiers and Multidisciplinary Activities (EFMA)

Emerging Frontiers in Research & Innovation

FY18 Solicitation: NSF 17-578

Informational Webinar

September 7th, 2017

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AGENDA
September 7th, 2017

1:00 pm Welcome from Clark Cooper, Deputy Assistant Director, NSF/ENG

1:05 pm Introduction of EFRI Team Members

- **Sohi Rastegar, *Head, EFMA***
- **Kerstin Mukerji, *Program Manager, EFMA***

- **CEE: Leon Esterowitz – *ENG/CBET – Topic Coordinator, CEE***
- **Louise R. Howe – *ENG/EFMA***
- **Shubhra Gangopadhyay – *ENG/ECCS***
- **Karen C. Cone – *BIO/MCB***
- **Anne W. Sylvester – *BIO/IOS***
- **Mitra Basu – *CISE/CCF***

- **C3 SoRo: Jordan Berg – *ENG/CMMI – Topic Coordinator, C3 SoRo***
- **Atul Kelkar – *ENG/CMMI***
- **Siddiq Qidwai – *ENG/CMMI***
- **Usha Varshney – *ENG/ECCS***
- **Reid Simmons – *CISE/IIS***

1:15 pm Overview of EFRI FY2018 Program Solicitation

2:00 pm Questions

Housekeeping Notes
DURING THE MEETING

During the webcast, you may send questions by E-mail:

- Send E-mail to: efri2018@nsf.gov

We will open the phone line for questions at the conclusion of the presentation. Instructions will be provided by the operator.

Housekeeping Notes
AFTER THE MEETING

- After the meeting, a recording of this webcast as well as a copy of the slides will be archived and available. Visit the EFMA website for information: http://www.nsf.gov/eng/efma

- After the meeting, you may submit questions by:
  - E-mail: efri2018@nsf.gov
  - Phone: 703-292-8305 (AFTER THE MEETING ONLY)

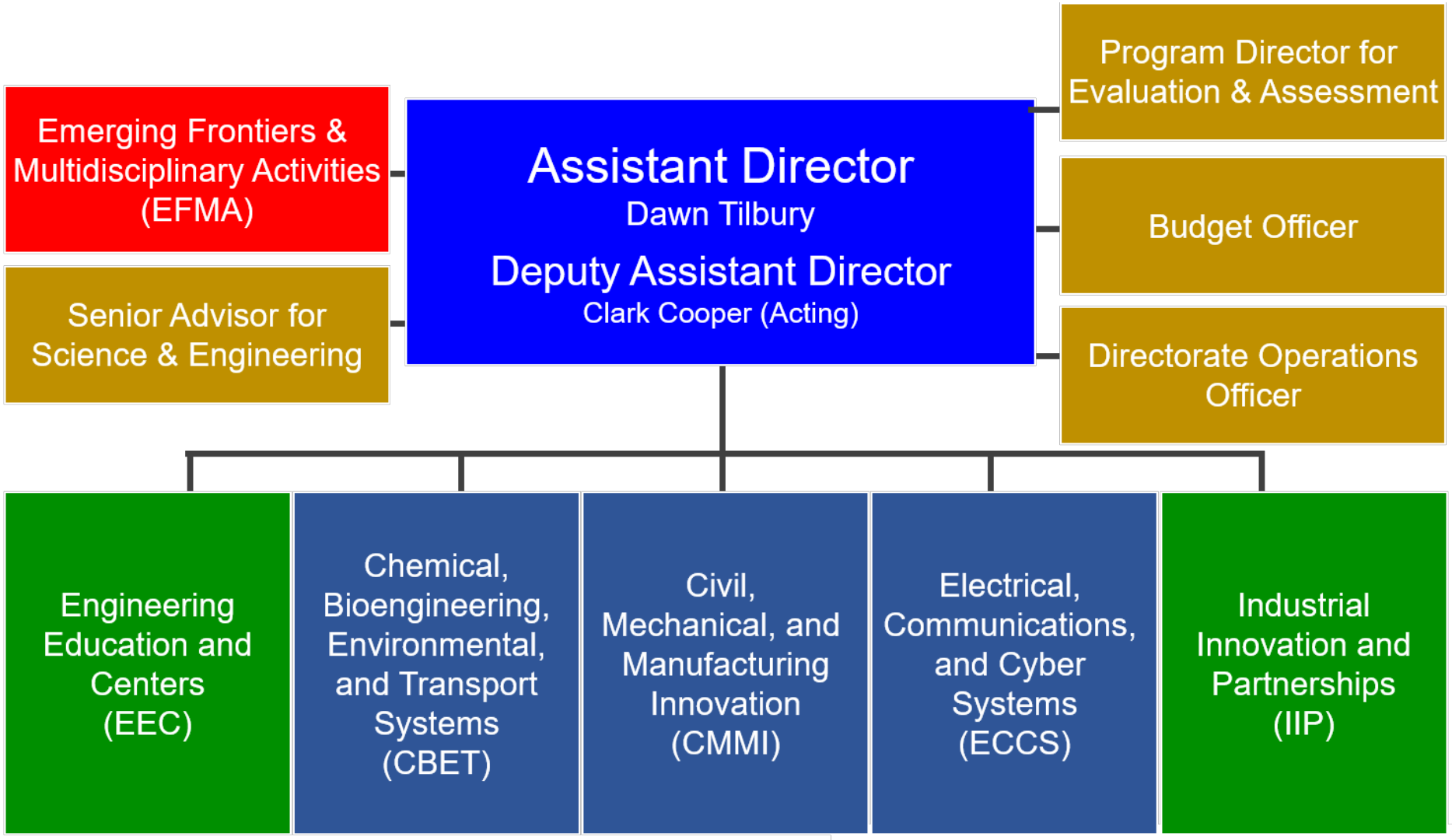
Key website

- Office of Emerging Frontiers & Multidisciplinary Activities (EFMA) Website:

http://www.nsf.gov/eng/efma

- Please refer to this website for up-to-date information.

Directorate for Engineering (ENG)



Goals of Webcast

The goals of this webcast are:

- To inform the community about the EFRI FY 2018 Program Solicitation

- To respond to questions from potential applicants.

The Emerging Frontiers in Research & Innovation (EFRI) Program

The EFRI Program serves a critical role in helping the Engineering Directorate to focus on important emerging areas in a timely manner.

- **Community Driven** – Engages the research community (through a DCL) as well as NSF PDs to identify and fund a portfolio of projects in strategic emerging, interdisciplinary areas that may not be supported through current NSF programs, and in which ENG research plays the leading role.
- Uses **Potentially Transformative** / **High risk, High reward** and **Interdisciplinary** as criteria for project selection.
- Signature midscale project-funding mechanism in ENG ($2M / 4 year projects)

EFRI Topics: FY2007-2017

FY07	ARES: Autonomously Reconfigurable Engineered Systems CBE: Cellular and Biomolecular Engineering
FY08	COPN: Cognitive Optimization and Prediction RESIN: Resilient and Sustainable Infrastructures
FY09	BSBA: Biosensing and Bioactuation HyBi: Hydrocarbons from Biomass
FY10	SEED: Science in Energy and Environmental Design RESTOR: Renewable Energy Storage
FY11	M3C: Mind, Machines, and Motor Control MIKS: Engineering based on Multicellular and Interkingdom Signaling
FY12/13	BioFlex: Flexible Bioelectronics Systems PSBR: Photosynthetic Biorefineries ODISSEI: Origami Design for Integration Of Self-assembling Systems For Engineering Innovation
FY14/15	2-DARE: 2-Dimensional Atomic-Layer Research and Engineering
FY16/17	ACQUIRE: Advancing Communication Quantum Information Research Engineering NewLAW: New Light and Acoustic Wave Propagation: Breaking reciprocity and time-reversal symmetry

EFRI FY 2018 Topics

- Chromatin & Epigenetic Engineering

  (CEE)

- Continuum, Compliant, and Configurable Soft Robotics Engineering

  (C3 SoRo)

Partners:

- ENG, BIO, CISE
- Air Force Office of Scientific Research

TOPIC 1: Chromatin and Epigenetic Engineering (CEE) Part 1

Precise regulation of cells, not merely through genetic manipulation but also through engineering changes at the epigenomic level, may enable us to combat disease, engineer crop plant improvements, and design organisms that can remediate environmental problems or adapt to environmental change.

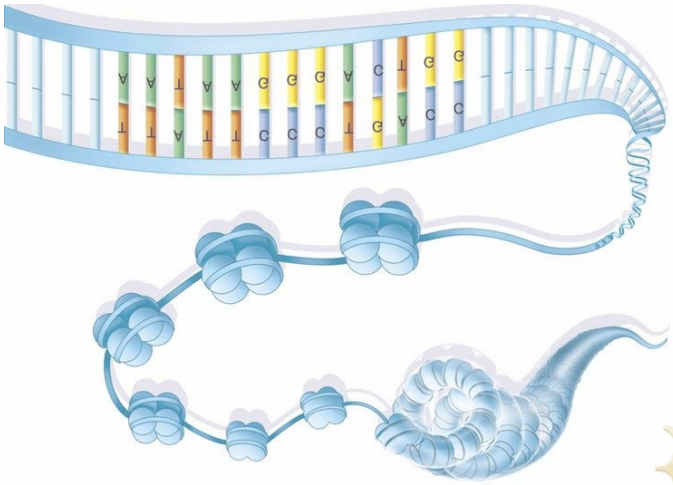
TOPIC 1: Chromatin and Epigenetic Engineering (CEE) Part 2

- **Cellular phenotype** is dictated by both genomic and epigenomic determinants.
- **Epigenomic regulation** is achieved, at least in part, through covalent modifications of the molecular components comprising chromatin – DNA and histone proteins – resulting in chromatin conformational change.
- Gene expression is thus a dynamic function of the **chromatin nano-environment**.
- **Decoding and manipulating epigenetic processes** will require a convergence of engineering approaches, molecular dynamics and molecular systems modeling, computational genomics, and nanoscale measurement and imaging.

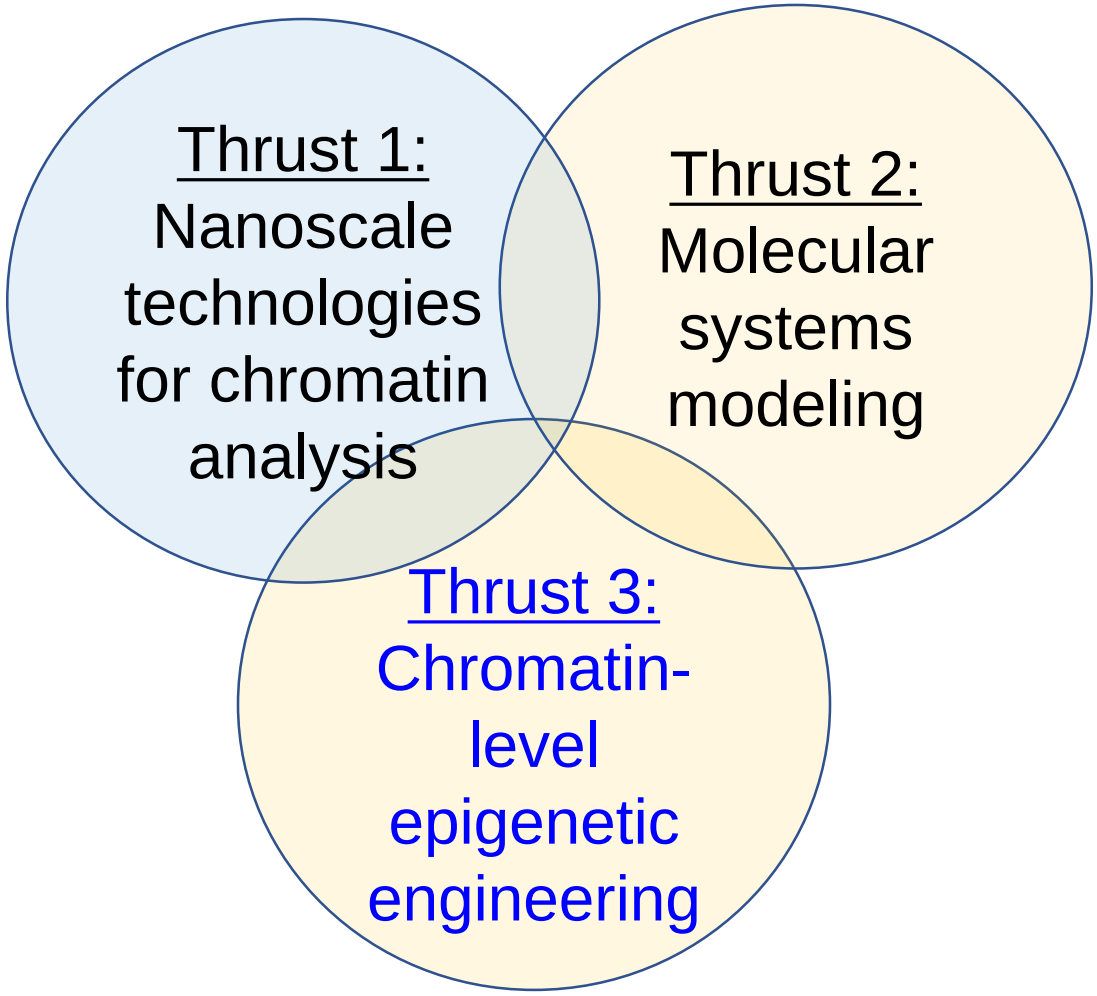
Chromatin and Epigenetic Engineering (CEE)

EFRI 2018 Team Members

- **Leon Esterowitz (ENG/CBET) – CEE Topic Coordinator**
  - Louise R. Howe, ENG/EFMA
  - Shubhra Gangopadhyay, ENG/ECCS
  - Karen C. Cone, BIO/MCB
  - Ann W. Sylvester, BIO/IOS
  - Mitra Basu, CISE/CCF



CEE: Research Thrusts



Thrust 1: Nanoscale Technologies for analysis of chromatin in living systems

Overarching Goal: Relate molecular modifications and interactions to chromatin structure and, ultimately, to phenotype in normal and disease states.

Decoding the role of the supra-nucleosomal chromatin code and the chromatin nano-environment in determining phenotype requires the development and application of **novel nanoscopic technologies** to:

- Measure
- Image
- Manipulate

nanoscale chromatin structure, dynamics, and environment **in live cells**.

Thrust 2: Molecular systems modeling

Understanding epigenetic regulation of phenotype will require the integration of molecular and physical data obtained in physiologically accurate physicochemical environments using multiscale modeling approaches.

Data might include:

- Genome-scale data on molecular chromatin modifications and associated transcriptional output
- Nanoscale imaging data
- Perturbations induced by intrinsic or extrinsic signals

Systems-level mathematical modeling should be deployed to integrate complex data and theory to inform our understanding of the chromatin-to-phenotype connection.

Thrust 3: Chromatin-level epigenetic engineering

Goal: **Engineer desired traits into a model system**, via control of the epigenome and chromatin structure, thereby validating:

- Tools developed in Thrust 1; *and/or*
- Models developed in Thrust 2

Potential Test beds *(not an exhaustive list)*:

- Reprogramming cancer cells to normalize global gene expression patterns
- Increasing crop plant species' tolerance to stress
- Generating CO_2-consuming, energy-producing organisms

CEE Requirements

- Interdisciplinary team
- At least one engineering investigator
- Inclusion of a biologist is strongly encouraged
- Research plan must address at least two of the three thrusts
- PIs must consider the ethical, environmental and regulatory implications of their proposed research, and discuss these as appropriate

TOPIC 2: Continuum, Compliant, and Configurable Soft Robotics Engineering (C3 SoRo)

Soft robots fully utilizing the configurability offered by compliant, continuously deformable structures would be capable of unprecedented functionality, both for stand-alone operation, and for close physical integration with humans.

To achieve this goal will require transformative engineering advances in power and information systems, mechanics and materials, and theories of movement and manipulation.

Continuum, Compliant, and Configurable Soft Robotics Engineering (C3 SoRo)

EFRI 2018 Team Members

- **Jordan M. Berg (ENG/CMMI) – C3 SoRo Topic Coordinator**
  - Atul Kelkar, ENG/CMMI
  - Siddiq Qidwai, ENG/CMMI
  - Usha Varshney, ENG/ECCS
  - Reid G. Simmons, CISE/IIS

C3 SoRo:
Background

- Soft robotics has recently emerged as a field distinct from traditional rigid robotics, posing major fundamental engineering challenges commensurate with its enormous potential benefits.
- Exciting proof-of-concept demonstrations illustrate specific achievements, but a complete engineering framework is lacking.
- Biology provides examples of organisms that use compliant structures to achieve versatility and adaptability of function. These examples can provide inspiration and guidance, but engineers need not be restricted to bio-mimetic solutions.
- Robots built from compliant materials can interact and interface with soft tissue with minimal mechanical damage.

C3 SoRo:
Expected Transformative Benefits

Potential outcomes of a new science of soft robotics include:

- A new class of autonomous robots capable of adapting their structures to accomplish unstructured tasks in variable and uncertain environments.
- A new class of wearable robots capable of augmenting human strength and endurance, providing new modes of locomotion and manipulation, and mitigating musculoskeletal disabilities.
- A new class of biomedical robots capable of being implanted in the human body to provide therapy or assistance to failing/damaged organs and structures.

C3 SoRo:
Continuum Structures

- **Continuum Structures** possess a high number of degrees of freedom, and may attain a wide variety of different shapes.
- In the context of this topic, these degrees of freedom should accommodate large deformations.
- Not all degrees of freedom need to be actuated.

C3 SoRo:
Compliant Structures

- **Compliant Structures** may be readily deformed by external forces.
- Together with a large number of degrees of freedom, compliance implies that the space of possible configurations of the structure is very large.
- Structures made entirely of soft materials are intrinsically compliant.
- Compliant structures, such as cables, may be made from non-soft materials.

C3 SoRo:
Configurable Structures

- In the context of this topic, **Configurable Structures** display a significant degree of functionality over a wide range of configurations.
- Different configurations may include substantial changes in shape as well as different topologies.
- Function may change with configuration.

C3 SoRo:
Objectives

- C3 SoRo projects should show how a large space of accessible configurations may be used to provide robustness, adaptability, and versatility under uncertain and unexpected conditions.
- C3 SoRo projects should provide a progressive vision for future breakthroughs, and should try to avoid results that do not show a clear path toward more capable systems.
- C3 SoRo projects should have the potential to result in innovative accomplishments in all of the required research thrust areas.

C3 SoRo:
Research Thrusts

1) Dynamic Modeling of C3 Robots

2) Distributed Sensing, Actuation, and Computation

3) Validation & Testing

Thrust 1: Dynamic modeling of C3 robots

Goal: Formulate and validate a family of computable mathematical representations of dynamic, intrinsically compliant materials and structures suitable for uses from high-fidelity simulation to parametric design to real-time motion planning and control.

Requires:

- New perspectives on motion control and path planning to accommodate high dimensional configuration spaces
- Means of modeling, estimating and controlling interface forces between compliant/variably compliant appendages and other objects (or of self interactions)

Models should extend beyond proof of validation using simplified test specimens and idealized loading conditions.

Thrust 2: Distributed sensing, actuation, and computation

Goal: Create and realize devices and architectures implementing the models generated in Thrust 1.

Devices should:

- Be compatible with open-loop and feedback control of complex, highly compliant/controllably compliant structures
- Include methods of distributed computation, sensing and actuation
- Include means for storing and distributing power and information, assembly and integration

Areas of interest include sensors, actuators, circuits, interconnects, packaging, and information processing systems capable of functioning while embedded in a highly compliant structure.

Novel materials, including living tissue, are of interest, when explored in the context of architectures capable of local state awareness and distributed control. Also needed are constitutive theories to rigorously explore materials' potential and utility.

Thrust 3: Validation & Testing

Goal: Fabricate and demonstrate physical platforms for experimental validation, rigorous proofs of concept, and comprehensive evaluation of robots in a variety of tasks and situations.

Requires demonstration of elements from Thrusts 1 & 2 integrated in a robust testbed and capable of achieving an illustrative goal under non-ideal conditions.

Systems should maintain functionality under substantial morphological variation, and should illustrate feasible pathways to integrated soft robotics solutions.

C3 SoRo Requirements

- Interdisciplinary team
- At least one engineering investigator; with collaborations between engineering disciplines
- Robust collaborations with researchers from other disciplines is strongly encouraged
  - e.g. Computer Science, Biology, Material Science, Chemistry, Mathematics
- Research plan must meaningfully incorporate all three research thrusts
- PIs should be mindful of the ethical, social, economic, legal and environmental implications surrounding innovations in soft robotics, and should discuss these considerations as appropriate

Solicitation Requirements

Award Size and Information

- Team Proposals Only:
  - 3-5 PIs/co-PIs
- Award size will depend on the type of research program proposed
- Up to 4 years in duration
- Up to $2M over grant lifetime (including both direct and indirect costs)
- Up to $26M in FY 2018 for entire competition, subject to availability of funds

Eligibility: PIs & co-PIs

- **PI Limit:**
  - Principal Investigators (PI) must be full-time tenured or tenure-track faculty as determined by the submitting organization.
  - A minimum of one PI and two co-PIs must participate.
  - Maximum number of PI plus co-PIs: 5
  - At least one PI or co-PI must be full-time faculty in a College or Department of Engineering

- **Limit on Number of Proposals per Organization:**
  None Specified.

- **Limit on Number of Proposals per individual (PI or co-PI): One**

  The PI and co-PIs may participate in only one proposal submitted to this solicitation. It is the responsibility of the submitting institution to ensure that the PI and all co-PIs are participating in only one proposal submitted to this solicitation.

Eligibility: Organizations

- **Organization Limit:**
  - EFRI proposals may be submitted by a single organization or by a group of organizations consisting of a lead organization in partnership with one or more partner organizations.
  - Only U.S. academic institutions which perform research and with degree-granting education programs in disciplines normally supported by NSF are eligible to be the lead organization.
  - Academic institutions are defined as universities and two- and four-year colleges (including community colleges) accredited in, and having a campus located in the United States, acting on behalf of their faculty members.
  - For interaction with industry, when appropriate for the proposed research, the GOALI mechanism (Grant Opportunities for Academic Liaison with Industry) may be used. https://www.nsf.gov/pubs/policydocs/pappg17_1/pappg_2.jsp - IIE4

No Collaborative Proposals

- For each proposed project, a single proposal should be submitted by the lead institution with subawards to partners institutions
- **No "Collaborative Proposals" are permitted**

  - *The proposal will include a budget for each of the four years proposed. FastLane will automatically provide a cumulative budget.*

  - *Preliminary proposals should not include detailed subcontracts; however the budget justification should include planned levels for subcontracts to any partner institution(s). Enter the anticipated total level of subcontract support on line G5, Subawards*

Broadening Participation Plan

- ENG promotes diversity in all aspects of its programs.
- As part of the EFRI 2018 Solicitation, EFRI requires all projects to include a Broadening Participation Plan.
- The goal is to increase the participation of underrepresented groups in the field of engineering and in engineering research.
- Promoting diversity in the human resources engaged in the EFRI projects should concomitantly expand diversity of thought, ideas, and approaches to defining and solving important research questions.

Broadening Participation Activities: Examples

- Inclusion of persons from underrepresented groups as PI, Co-PI, and/or other senior personnel, as appropriate for the project
- Inclusion of persons from underrepresented groups as graduate students, undergraduate students, and post-doctoral researchers
- Plans to apply for post-award supplements to engage undergraduate researchers and teachers, using REU & RET supplements, and/or graduate researchers, using Graduate Research Diversity Supplement
- Engagement of faculty and/or student researchers at minority serving institutions, community colleges, or high schools in the research project
- Enhancement of/collaboration with existing diversity programs at your home institution and/or nearby institutions
- Senior Personnel serving as role models and mentors for an underrepresented student population
- Providing tutoring opportunities for underrepresented middle school, high school, and undergraduate students
- Outreach activities that will interest and attract underrepresented K-12 students to engineering undergraduate programs

A Letter of Intent (LOI) Is Required
Due Date: September 29th, 2017

- A Letter of Intent is REQUIRED
- One Page
  1. **TITLE** - Title of the EFRI proposal preceded by the words “EFRI CEE:” or “EFRI C3 SoRo:” as appropriate
  2. **TEAM** - Names, departmental and university affiliation, and expertise of the PI and at least two co-PIs
  3. **SYNOPSIS** (**GOALS**) - Brief description of the specific goals of the proposal (maximum 250 words)
- Additional Requirement (only for LOI):
  - Sponsored Projects Office (SPO) Submission is **not** required
  - A Minimum of 2 and Max. of 4 Other Senior Project Personnel (co-PIs)
  - A Minimum of 0 and Max. of 3 Other Participating Organizations
- LOIs are not merit reviewed and no feedback is provided to the submitters
- A Letter of Intent is REQUIRED
- Submission of multiple LOIs is NOT permitted

Preliminary Proposals Are Required
Due Date: October 25th, 2017

- Must be submitted through FastLane and meet formatting requirements in NSF Proposal & Award Policies and Procedures Guide (PAPPG) https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg
- Project Summary (one page limit)

  Preliminary proposals that do not separately address both intellectual merit and broader impacts in the Project Summary will be returned without review
- Project Description (five page limit) includes:
  1. Vision and Goals (~1 page)
  2. Approach and Methodology (~3 pages)
  3. Transformative Impact (~1 page). Describe the transformative aspects of the project including how the synergy of experts from different disciplines will achieve a significant advancement of fundamental engineering knowledge and will have strong potential for long term impact on a national need or grand challenge. Include a succinct statement of your preliminary Broadening Participation Plan.
- References Cited; Biosketches; Current/Pending Support; Budget

Preliminary Proposal: Additional Documentation
Submit Via FastLane

- Supplementary Documentation: **List of Key Personnel** (one page limit)

  Provide a succinct description of what each person uniquely brings to the project and how their expertise will be integrated to foster synergy

- Single Copy Documents: **Collaborators & Other Affiliations**

  Effective April 24th 2017, NSF requires the use of a specific spreadsheet template for identifying COA information. More information on this and a link to the required NSF COA spreadsheet template can be found at the following site - https://www.nsf.gov/bfa/dias/policy/coa.jsp

  This document must be submitted for each PI, co-PI, and every other senior project personnel member.

  Failure to submit this information may result in a proposal being returned without review.

Email Additional Information to NSF
Immediately After Submission of Preproposal

- Submit via email to efri2018@nsf.gov

  A single PowerPoint slide summarizing the vision of the EFRI proposal. This will be used during review panel discussions of the Preliminary Proposals.

- Do not use Fastlane to submit this document

Full Proposals Will Be Invited By Late Dec. 2017

Submission Due Date: February 23rd, 2018

- Follow NSF Proposal & Award Policies & Procedures Guide or Grants.gov Application Guide
- Project Summary
  - Proposals that do not separately address both intellectual merit and broader impacts in Project Summary will be returned without review
- Project Description (15 page limit)
  - Must end with a section labeled **IMPACT**
- Additional Sections include:
  - References Cited; Biosketches; Current and Pending Support; Budget; Facilities and Equipment
- Proposal budget must include funds for travel by PI and one graduate student or researcher to attend an annual EFRI grantees' meeting. Awardees will be required to attend and present their research annually at an EFRI grantees' conference for the duration of the award.

Full Proposal: Additional Documentation
Submit Via FastLane

- Supplementary Documentation:

  List of Key Personnel: Provide a description of what each person uniquely brings to the project and how their expertise will be integrated to foster synergy (3 pages max)

  Provide a detailed **management plan** (3 pages max)

  Provide a **data management plan** (1 page max)

  Post-doc mentoring plan, if requesting support for post-doc(s)

  Mechanisms for sharing the outcomes of the research

  Broadening Participation Plan – additional information up to 5 pages

- Single Copy Documents: **Collaborators & Other Affiliations**

  Effective April 24th 2017, NSF requires the use of a specific spreadsheet template for identifying COA information. More information on this and a link to the required NSF COA spreadsheet template can be found at the following site - https://www.nsf.gov/bfa/dias/policy/coa.jsp

  This document must be submitted for each PI, co-PI, and every other senior project personnel member.

Email Additional Information to NSF
Immediately After Submission of Proposal

- Submit via email to efri2018@nsf.gov

  A single PowerPoint slide summarizing the vision of the EFRI proposal. This will be used during review panel discussions of the Proposals.

- Do not use Fastlane to submit this document

Review & Award Process

- Required Letters of Intent due on **September 29, 2017**
- Preliminary Proposals due on **October 25, 2017**.
- Based on the reviews, a limited number will be invited **by late December 2017** to submit full proposals.
- Invited Full Proposals are due on **February 23, 2018**.
- Invited Full Proposals will be reviewed in **Spring/Summer 2018**.
- Awards are expected to be made, subject to availability of funds, **by September 2018**.

Review Criteria

- NSB-approved Merit Review Criteria
  - Intellectual Merit
  - Broader Impacts
- NSF Program Staff will also give careful consideration to the following:
  - Integration of Research and Education
  - Integrating Diversity into NSF Programs, Projects and Activities

Review Criteria:
EFRI Solicitation-Specific

- **TRANSFORMATIVE -** Does the proposed research represent an opportunity for a significant leap or paradigm shift in fundamental engineering knowledge?
- **NATIONAL NEED/GRAND CHALLENGE -** Is there potential for making significant progress on a national need or grand challenge?
- **Broadening Participation Plan -** Does the plan actively promote, increase, and enhance the participation of underrepresented groups in the field of engineering and in engineering research?
- Effectiveness of the proposed **Management Plan.**

EFRI-2018 (NSF 17-578)
Important Solicitation Dates

Sept 7th, 2017	Informational Webinar
Sept 29th, 2017	Letter of Intent Due (required)
Oct 25th, 2017	Preliminary Proposal Due (required)
Feb 23rd, 2018	Full Proposal Deadline (by invitation only)

Frequently Asked Questions:
Participation Limit

Question:

Can an investigator be PI on one proposal and co-PI on another proposal?

Answer:

No. Each investigator may participate as either PI or co-PI on only a single proposal.

Frequently Asked Questions:
Co-PI Limit

Question:

How many co-PIs can be included on a single proposal?

Answer:

Each proposal *must* have a minimum of 2 co-PIs and a maximum of 4 co-PIs

Frequently Asked Questions:
Engineer PI/co-PI

Question:

Is it required to have a PI/co-PI from Engineering?

Answer:

The Lead PI or one of the project co-PIs *must* be full-time tenured or tenure-track faculty within a College or Department of Engineering

Frequently Asked Questions:
Industry co-PI

Question:

Can a person from industry serve as a co-PI?

Answer:

For interaction with industry, when appropriate for the proposed research, the GOALI mechanism (Grant Opportunities for Academic Liaison with Industry) may be used. See PAPPG Chapter II.E.4.
https://www.nsf.gov/pubs/policydocs/pappg17_1/pappg_2.jsp#IIE4

Frequently Asked Questions:
Co-PI from a non-US institution

Question:

Can a person from a non-US institution serve as a co-PI?

Answer:

The NSF Proposal & Award Policies and Procedures Guide (PAPPG) NSF17-1, Chapter I.E.6 states:

Foreign Organizations *– NSF rarely provides support to foreign organizations. NSF will consider proposals for cooperative projects involving US and foreign organizations, provided support is requested only for the US portion of the collaborative effort.*

Frequently Asked Questions:
Consultants

Question:

Can professional engineers be consultants on an EFRI proposal ?

Answer:

Yes.

Frequently Asked Questions:
Participating Institutions

Question:

How many participating institutions are allowed on an EFRI proposal?

Answer:

There is no limit to the number of participating institutions allowed on an EFRI proposal.

(Limits are imposed in the Letter of Intent purely for administrative purposes so that key individuals and organizations can be identified early on)

Frequently Asked Questions:
LOI Format

Question:

Do you have any formatting requirements for the Letter of Intent (font, size, margins, etc)?

Answer:

Fastlane templates will walk you through submitting the Letter of Intent and automatically format the LOI.

Please prepare your text in a word-processing (or similar) program on your computer and cut and paste the required information into Fastlane.

Acronyms and Terminology

- **AFOSR** Air Force Office of Scientific Research
- **BIO** Biology Directorate
- **CISE** Computer and Information Science and Engineering Directorate
- **ENG** Engineering Directorate

- **CBET** Chemical, Bioengineering, Environmental, and Transport
- **CCF** Computing and Communication Foundations
- **CMMI** Civil, Mechanical, and Manufacturing Innovation
- **Co-PI** Co-Principal Investigator
- **ECCS** Electrical, Communications and Cyber Systems
- **EEC** Engineering Education and Centers
- **EFRI** Emerging Frontiers in Research and Innovation
- **IIP** Industrial Innovation and Partnerships
- **IOS** Integrative Organismal Systems
- **IIS** Information & Intelligent Systems
- **MCB** Molecular and Cellular Biosciences
- **NSF** National Science Foundation
- **NSB** National Science Board
- **PI** Principal Investigator

EFMA website

- Please refer to the EFMA website for current information.

www.nsf.gov/eng/efma