Grants for Exploratory Academic Research (GEAR)

SC EPSCoR Solicitation Number 12-GE2021

GEAR Program Objectives

The goal of the Grants for Exploratory Academic Research (GEAR) Program is to encourage faculty researchers at South Carolina's Comprehensive Research Universities (CRUs) (Clemson University, Medical University of South Carolina, and University of South Carolina Columbia campus to compete effectively for research funding to support the:

- Research clusters associated with the National Science Foundation (NSF) Research Infrastructure Improvement (RII) Track 1-Award entitled "***Materials Assembly and Design Excellence in South Carolina" (MADE in SC)***. The vision of this initiative is to discover and establish new and sustainable approaches for the design and assembly of hierarchical materials at multiple relevant length scales that service South Carolina's STEM research, education, and workforce needs and invigorate economic development. The focus of this initiative is to discover and develop new intelligently designed optical and magnetic materials, stimuli-responsive polymeric materials, and interactive biomaterials.

- Research clusters associated with South Carolina's next National Science Foundation (NSF) Research Infrastructure Improvement (RII) Track-1 proposal topic titled "***AI-Enabled Devices for the Advancement of Personalized and Transformative Healthcare (ADAPT)***". The goal of the ADAPT project is to harness the power of artificial intelligence (AI) to improve public health in South Carolina (SC), which ranks 41st in the nation. The key to reducing SC's health disparities is early diagnosis and appropriate treatment tied to individual needs, which can be achieved by developing personalized medicine. Personalization of medical devices promises to substantially improve health outcomes compared with medical devices developed using current approaches. The ADAPT project will focus on XAI-enabled biomedical devices for diagnostic applications, AI-enabled biomedical devices for prognosis and/or treatment, and AI-enabled rehabilitation biomedical devices.

Proposals submitted in response to this solicitation:

- must be a collaboration between two investigators from South Carolina's three comprehensive research universities (Clemson University, the Medical University of South Carolina, and the University of South Carolina Columbia).

- ***MADE in SC Proposals Only*** - proposed research must be collaborative, demonstrates a connection between experiments and MCC efforts (theory, computation, simulation, etc.), and be clearly aligned with the Materials Genome Initiative (MGI).
- preferably, the collaboration is between a senior faculty member and a junior faculty member. Senior faculty members are those who are at the full professor level or who have been at the associate professor level for more than two years.

MADE in SC Research Priorities

Proposals must respond to one of the following specific research thrusts. Proposals must address one or more of the activities listed in the Attachment titled, "List of Strategic Research Goals and Activities." The four research clusters of MADE in SC are:

- **Modeling and Computation Core (MCC).** The goal of the MCC is to develop multiscale models and computational tools synthesizing theories, methods, and infrastructure to provide optimized solutions for the materials system. Supporting goals are the development of advanced multiscale theoretical foundations, fast algorithms to handle high throughput computations, high resolution/fidelity imaging and visualization, and big data analytics including uncertainty quantification.
- **Research Thrust 1 – Hierarchical Structures with Controlled Optical, Electrochemical, and Magnetic Properties**. The goal of Thrust 1 is to explore the inorganic crystal structure and mesoscale assembly of hybrid inorganic and organic materials to control and tailor their optical and magnetic properties. These designed materials and assemblies will exhibit multi-functional, correlated, collective properties leading to, e.g., materials for enhanced energy transfer for lasing and harvesting applications.
- **Research Thrust 2 – Stimuli-Responsive Polymeric Materials**. The goal of Thrust 2 is design and develop synthesis strategies for polymers able to respond to external cues leading to, e.g., materials for efficient water treatment and self-repairing materials for harsh environments.
- **Research Thrust 3 – Rational Design of Interactive Biomaterials.** The goal of Thrust 3 is to develop a fundamental understanding of the effect of physical and chemical signals on cellular behavior across a range of length scales, leading to the development of interactive biomaterials, e.g., for use in regenerative medicine.

ADAPT Research Priorities

ADAPT seeks to address current challenges in development of AI-enabled medical devices: (1) how to extend explainable AI (XAI) theories to trustworthy and understandable AI-enabled diagnostic medical devices in practice and make personalized predictions, (2) how to establish new deep learning (DL) models to integrate information from multimodal data to ensure more effective design of a medical device, and (3) how to leverage existing data and models for like patients and

further develop generative adversarial networks to create virtual characters as the new generation of digital twins (DTs) for developing personalized medical devices.

Proposals must respond to one of the following specific research thrusts. The three research clusters of ADAPT are:

- **Research Thrust 1 – XAI-Enabled Biomedical Devices for Diagnostic Applications**. The goal of Thrust 1 is to develop the fundamental science for creating XAI-enabled biomedical devices for spatiotemporal, enriched, large data. The aim is to build upon existing expertise in sensors, biochip-based fabrication, data fusion, AI, and causal inferences. The goal is to advance the field of biomedical devices into trusted, fair, and smart autonomous sensing systems. Fundamental knowledge will be gained on how to apply and enable these devices for causal reasoning and fast, accurate decision-making.
- **Research Thrust 2 – AI-Enabled Biomedical Devices for Prognosis and/or Treatment**. The goal of Thrust 2 is to conduct fundamental research on creating DL models for AI-enabled biomedical devices for prognosis and/or treatment from limited data. The aim is to advance the field of AI-enabled medical devices for prognosis and/or treatment. An expected outcome is fundamental knowledge that governs generating high-performance, generalizable DL algorithms from limited data.
- **Research Thrust 3 – AI-Enabled Rehabilitation Biomedical Devices**. The goal of Thrust 3 is to develop DT in the rehabilitation industry and to develop a platform that can be used for patients in various medical categories and communities. The aim is to develop medical devices for rehabilitation applications aided by the DT concept – a digital model of the rehabilitating target that recapitulates the physical body of the patient and is able to predict the future outcome using computational models of the patient's physiology, rehabilitated body parts, and physical well-being.

Award Information

Award Type: Grant

Maximum Funding Amount Per Project: $60,000.00

Project Duration: 18 months

Estimate Number of Awards: Depends on quality of proposals and availability of funds.

Eligibility

Proposals may be submitted by a Principal Investigator from Clemson University, the Medical University of South Carolina, or the University of South Carolina Columbia. Current GEAR PIs and GEAR CRP PIs whose awards end before January 1, 2022 are eligible to apply and can serve as Co-PI.

Deadline

Full Proposal – Monday, March 14, 2022 – 5:00PM EST

Full Proposal Content

The sections below represent the body of the proposal. Failure to submit the required sections will result in the proposal not being accepted or being returned without review. *Note: Where indicated, the number of pages refers to the maximum number of pages allowed and must not be exceeded.*

1. **Cover Page (2 Pages)**

   Use the Cover Page form in Appendix A.

2. **Project Summary (1 Page)**

   Each proposal must contain an NSF compliant summary of the proposed project not more than one page in length. The Project Summary consists of an overview of the activities that would result if the proposal were funded, and a brief description of long-term plans for sustainability. The Project Summary must also include a statement of objectives and methods to be employed, and two distinct sections: 1) statement on the intellectual merit of the proposed activity, and 2) a statement on the broader impacts of the proposed activity. **MADE in SC Proposals Only** – Project summary should specifically identify the research thrust areas and articulate the integration of modeling/simulations with experimental research.

3. **Project Description (8 Pages)**

   The Project Description should provide a clear statement of the work to be undertaken and must include the best scientific and strategic (long-term) objectives of the proposed work and expected significance, the relationship of this work to the present state of knowledge in the field, and the work plan. The Project Description section should have the following sections:

   a. **Objectives of the Proposed Work and Relevance**

      MADE In SC Proposals - State the objectives of the proposed work and explain how it relates to ***MADE in SC*** research priorities outlined in the Program Objectives section and integration of modeling/simulation with experimental research. Proposers must identify the activity or activities that the proposal addresses from the "List of Strategic Research Goals and Activities" by specifying the Goal, Objective and the specific activity or activities.

      ADAPT Proposals – State the objects of the proposed work and explain how it relates to ADAPT research priorities outlined in the Program Objectives section.

   b. **Prior Relevant Research**

      Describe the proposed research project including significance of research, research topic, and relevant literature related to the proposed work.

c. General Research Plan

Describe the research framework, hypothesis, research questions, methods and procedures, potential outcomes, etc. Describe the broad design of activities to be undertaken (e.g., experimental methods and procedures). Proposers should address what they want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits could accrue if the project is successful. The research activities may be based on previously established and/or innovative methods and approaches, but in either case must be well justified. These issues apply to both the technical aspects of the proposal and the way in which the project may make broader contributions. Proposers must clearly identify the accomplishments to be expected at the end of the project. Specific milestones must be carefully stated to aid in proposal evaluation.

d. *MADE in SC Proposals Only* - Alignment with the Materials Genome Initiative (MGI)

Describe the alignment of the proposed research with the Materials Genome Initiative (MGI) and explicitly identify how the proposed research connects with the MGI approach, i.e., an iterative cycle for materials design. Proposals must follow **MGI Implementation Framework** adopted by MADE in SC to demonstrate alignment with the MGI in an iterative loop to accelerate the materials research/development/discovery process. The implementation requires the integration of at least two of the following three elements:

- Physical experiments (EXP)
- Theory, modeling and/or numerical simulations (TMS)
- Data science including databases (DS/DB)

Each proposal should clearly articulate how the iterative loop will be implemented and how this loop is closed to accelerate materials research. More on the MGI Implementation Framework can be found at: https://scepscor.org/MiSC/MGI-implementation_framework.html. This link also includes an example of a graphical depiction of the MGI Framework iterative process between at least two of the three elements for a specific research project. A similar graphic that appropriately depicts how the proposed research plans to implement the MGI Framework can be included in this section of the proposal.

4. Plans to Leverage GEAR Funding (2 Pages)

Describe the plans to leverage GEAR funding and explicitly address the targets and opportunities for future project funding and sustainability of the effort. Outline a plan for submitting research proposals to national and private funding agencies to attract research grants. The plan must include the names of potential agencies and the programs and dates (if known) that will be targeted.

5. References Cited

Reference information is required. Each reference must include the name of all authors (in same sequence in which they appear in the publication), the article and journal title, book title, volume number, page numbers, and year of publication.

6. Results from Prior SC EPSCoR Support (1 Page per Award)

The purpose of this section is to assist reviewers in assessing the quality of prior work conducted with current or prior SC EPSCoR Program funding. If either the PI or the Co-PI identified on the proposal has received an award as a PI from the SC EPSCoR Program since January 1, 2017, the following information must be provided:

- Title of the project, start date, date completed, and award amount.
- Summary of the results of the work completed, including accomplishments, supported by the award. The results must be separately described under two distinct headings: Intellectual Merit and Broader Impacts
- A listing of the publications resulting from the award (a complete bibliographic citation for each publication must be provided; if none, state "No publications were produced from this award".

If the project was recently awarded and therefore no new results may exist, briefly describe the proposed work.

7. Biographical Sketches (2 Pages per person)

A biographical sketch is required for the PI and the Co-PI. Biographical sketches of other senior personnel with whom the PI will collaborate may also be included. NSF format is required and must include and be limited to the following sections:

- **Professional Preparation** – undergraduate and graduate education and postdoctoral training (including location)
- **Appointments** – A list, in reverse chronological order, of all the individual's academic/professional appointments beginning with the current appointment.
- **Products** – A list of: (i) up to five products most closely related to the proposed project; and (ii) up to five other significant products, where or not related to the proposed project
- **Synergistic Activities** – A list of up to five examples that demonstrate the broader impact of the individual's professional and scholarly activities that focuses on the integration and transfer of knowledge as well as its creation.

For more information about NSF format, visit

https://www.nsf.gov/bfa/dias/policy/biosketch.jsp

8. Budget

Use the Budget forms in Appendix B. If the PI and Co-PI's are from different institutions, two different budget sheets must be submitted: one for the PI and one for the Co-PI. The PI's budget sheet Section F must show the Co-PI's total budget amount as a subaward.

9. Budget Justification (2 Pages)

The budget justification must be composed of no more than two pages and must include the following sections:

- Senior Personnel
- Other Personnel
- Fringe Benefits
- Materials and Supplies
- Equipment
- Domestic Travel Support
- Publication Costs
- Other Direct Costs

10. Current and Pending Support

The Principal Investigator and all senior personnel must complete Current and Pending Support document in Appendix C.

11. List of Conflicts

Provide conflicts of interest (COI) for Principal Investigator and Collaborators on Appendix D. Conflicted individuals to be identified for each project participant include:

- PhD Advisor: PhD Advisor of the participant (a direct advisor, not simply a thesis committee member) at any time in the past
- PhD Advisee: PhD advisee of the participant (a direct advisee, not simply where student is on thesis committee) at any time in the past
- Co-author: a co-author of the participant (includes papers under review and in preparation) within the past 48 months
- Co-PI: a co-investigator of the participant (includes proposals under review and in preparation) within the past 48 months
- Postdoc Advisor: Postdoc Advisor of the participant (a direct advisor, not simply a collaborator) within the past 48 months
- Postdoc Advisee: Postdoc Advisee of the participant (a direct advisee, not simply a collaborator) within the past 48 months
- Collaborator: a collaborator other than those listed above within the past 48 months (do not list individuals who have merely shared or received data, software, or other intellectual property)

- Co-editor: a co-editor of the participant during the past 24 months

Budget Information

Funding for the GEAR Program is intended to support salaries and fringe benefits, materials and supplies, domestic travel support, publication costs, tuition supplement, etc.

- The budget requested may not exceed $60,000.00 per proposal.
- A maximum of one month of summer salary for the PI and/or Co-PI is allowed. No other senior personnel may receive funding from this program.
- Salary support is allowed for Post-docs, student researchers, and other staff.
- Indirect costs are not allowed under this solicitation.
- Cost-share is not required but encouraged.
- Awardees should ensure that costs claimed under SC EPSCoR Program grants are allowable, allocable, and reasonable.

Submission Instructions

PIs should submit their proposals via the SC EPSCoR Proposal Submission Portal at https://scepscor.org/Solicitations/portal/index.php . If not previously registered in the Portal, please follow the instructions on the main Portal page to register.

Proposal Review Process

Proposals that meet the eligibility requirements and the guidelines of this solicitation will be evaluated by external reviewers (outside South Carolina) based upon the extent to which they meet specific criteria, including but not limited to:

- The potential of the proposed research to advance knowledge and understanding within the research priorities outlined in the Program Objectives section (Intellectual Merit).
- The potential for the proposed activity to benefit society, advance desired societal outcomes and broaden participation of groups that are under-represented based on gender, ethnicity, and disability (Broader Impacts).
- Whether the plan for carrying out the proposed activities is well-reasoned, well-organized, and based on a sound rationale, and whether it incorporates a mechanism to assess success.
- How well qualified is the PI/Co-PI team to conduct the proposed activities.
- The adequacy of available resources to carry out the proposed activities.
- ***MADE in SC Proposals Only*** - How well does the proposed research integrates modeling/simulations with experiments?
- The likelihood that the research will lead to extramural funding.
- How well does the proposed activity advance discovery while promoting, mentoring, training, teaching, and learning?

Award and Reporting Requirements

- ***MADE in SC Projects Only*** - All GEAR PIs and Co-PIs will be considered part of the MADE in SC Project and are expected to participate in MADE in SC activities which include attending meetings and contributing to the annual report submitted to the National Science Foundation (NSF).
- All publications (e.g., research publications, press releases, other publications or documents about the research funded by the SC EPSCoR Program) and presentations resulting from the GEAR must include an acknowledgement of SC EPSCoR Program support and a disclaimer. "*Research reported in this [publication, press release, presentation] was supported in part by the NSF (MADE in SC Projects Only) and SC EPSCoR Program under award number (NSF Award # OIA-1655740 (MADE in SC Projects Only) and specific SC EPSCoR grant number). The views, perspective, and content do not necessarily represent the official views of the SC EPSCoR Program nor those of the NSF (MADE in SC Projects Only)*."
- **MADE In SC Project Only** - GEAR awardees will be required to present their research findings at the SC EPSCoR and MADE in SC meetings.
- SC EPSCoR Program reserves the right to conduct site visits during the project period for evaluation and reporting purposes. Awardees are expected to provide required information and documentation to the SC EPSCoR Program staff and External Evaluator as needed.
- Reassurance of Responsible Conduct of Research (e.g., CITI Certification) are required for student researchers to be submitted to SC EPSCoR Program State Office.
- Progress reports are due every six months after the start date of the award. A template will be provided to the PIs.
- A final report will be due 60 days after the end of the award.

Contact Information

General inquiries regarding this program should be made to:

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