<p style="text-align:center">Request for Statements of Interest
Funding Opportunity Announcement</p>

Federal Awarding Agency:

U.S. Army Corps of Engineers,

Engineer Research and Development Center

3909 Halls Ferry Road

Vicksburg, MS 39180-6199

Funding Opportunity No.: W81EWF-22-SOI-0010

Statutory Authority: 10 USC 2358

Project Title: Innovative Technologies in Structural Health Monitoring for Condition Assessment and Future Reliability Prediction

Announcement Type: Initial announcement

Issue Date: 10 March 2022

Statement of Interest/Qualifications Due Date: 5pm CST 11 April 2022

Full Application Package Due Date, if Invited: 5pm CST 11 May 2022

Estimated Award Ceiling: $2,000,000.00

Estimated Total Program Funding: $12,000,000.00 Total $2,000,000.00 for the base year period of performance and $2,500,000.00 x 4 for four option years

Expected Number of Awards: One award

Section I: Funding Opportunity Description

Background:

U.S. federal and state government agencies manage and operate a range of infrastructure assets that protect property, the economy, environment, and lives from floods, droughts, and other catastrophic events. Much of this infrastructure was built many decades ago and needs costly repairs. Unfortunately, the total cost of needed repairs exceeds the funds which are available from state and federal budgets. Much of the U.S. large civil infrastructure was built 50 or more years ago and must be operated and maintained under tightening budgets. The development of asset management strategies to improve sustainability and resiliency of aging infrastructure is a crucial area of research and development that ultimately saves tax dollars through the prevention of infrastructure failures and loss of valuable assets including crops, homes, transportation routes, natural and cultural resources, and lives of those served by the structures.

Structural health monitoring is the science of making accurate condition assessments about the current and future ability of an asset or system of assets, particularly infrastructure assets, to perform its intended design function(s), based on sensor and inspection data, numerical engineering models, and statistical analyses. Structural health monitoring principles and technology can provide continuous measurements and simulations of our aging infrastructure to support real-time alerts of imminent failures and provide longer-term monitoring to accurately quantify asset and component condition, including remaining service life, risk assessment, and maintenance requirements. The tools and techniques investigated and developed through this research will be implemented directly onto as-yet-identified water-resources infrastructure applications which may include locks, dams, harbors, levees, piers, hydropower units, and more.

Brief Description of Anticipated Work:

The purpose of this research is to advance structural health monitoring (SHM) technologies, including innovative sensors, sensing modalities, telemetry, data analysis, feature extraction, numerical models, and statistical models, for their readiness for use by infrastructure portfolio managers to assess current future condition and reliability of infrastructure components and systems. The ultimate form in which these technologies will be utilized is a multi-scale digital surrogate model of specific infrastructure assets as identified by the government. All efforts toward the research objectives should be aligned with the basic tenants of ISO 55000 standards for asset management. Specifically, the objectives include:

Objective 1. Implementation/deployment of digital twins
Develop and deploy multi-scale digital surrogate models/digital twins of large civil infrastructure. The digital twin shall be deployed for specific water-resource asset(s) as identified by the government as part of this cooperative agreement. The digital twin must include visualization of decision support metrics with consideration of integration of augmented reality (AR) and/or virtual reality (VR) tools for use by the end user.

Objective 2. Non-contact sensing
Develop new or modify existing technologies to implement non-contact sensing of large scale, civil infrastructure that is otherwise difficult to physically access. Example modalities to consider can include, but are not limited to, computer vision, LiDAR, sonar, and ultrasonic. Sensing targets may be to supplement traditional contact sensing, and aim to acquire displacement, acceleration, strain, etc. Other targets of interest may be obtaining information specific to the visible spectrum, such as the presence of corrosion, spalling, scour, etc. Technologies shall be investigated for use above and below water with varying levels of turbidity, in environments and locations with limited lighting, etc. Methods developed shall be implemented on water-resources infrastructure identified by the government and shall be developed in a manner to be implemented directly into the digital twin outlined in objective 1.

Objective 3: Novel sensing and data acquisition
Implement existing or develop innovative sensors, sensing systems, data acquisitions, or sensing techniques for the efficient, accurate, and economical collection of data to support multi-scale digital surrogate models of large civil infrastructure systems. The developed methodologies shall address problems and specific infrastructure detection targets as identified by the government and shall be implemented/integrated into the digital twins outlined in objective 1.

Objective 4. Robotic/unmanned inspection
Modify existing technologies to be implemented in the remote/unmanned inspection of large-scale infrastructure. This should be leveraged as a platform to implement/deliver the methods developed in objectives 2 and 3, as well as other applicable methods found in the literature, and shall be in direct support of the development of the digital twins as outlined in objective 1. Acceptable target infrastructure shall be water resources infrastructure as identified by the government. Consideration shall be given to the integration of AR/VR technologies into the inspection platforms to allow for remote, real-time visualization and inspection of the targeted infrastructure.

Objective 5. Machine Learning/Artificial intelligence for data analytics and decision support

Develop new or modify existing data analytics methodologies for decision support of the infrastructure specified by the government. Develop new or modify existing ML/AI methods to facilitate the processing data gathered from methodologies outlined in objectives 2, 3 and 4 (and elsewhere) to support decision-making and integration into the digital twin framework outlined in objective 1. Develop new or modify existing ML/AI methods for control of robotic inspection platforms outlined in objective 4. Other methods investigated may include, but are not limited to, Bayesian risk and decision making for specific water resources infrastructure as identified by the government and model updating based on information gleaned from many sensing modalities.

Public Benefit:

This research will benefit the public through the advanced technologies developed in sensing, modeling, and systems engineering. The application of SHM technologies for making real-world decisions has been limited and the models and reports developed by this research will help to fill in the global and national gap of technology transfer in this field. State and federal agencies and academics will benefit from the new lessons learned and identification of knowledge gaps regarding applying SHM for large-civil infrastructure, which is a national and global problem. Further, any systems developed for pilots, prototypes, or demonstrations will benefit the public infrastructure on which it is applied.

Section II: Award Information

Successful applicants should have expert knowledge in the field of structural health monitoring and a record that demonstrates experience with researching and applying SHM principles to assets in an operational environment. The candidates shall be able to demonstrate a record of prior experience with use of statistical pattern recognition for detecting and assessing damage of structural systems. The candidates shall be able to demonstrate a record of experience with designing SHM systems to maximize the reduction of risk per dollar cost.

VSuccessful applicants should have expert knowledge and work experience in the field of structural health monitoring, especially with application to large complex structures. The objectives described herein will also require expertise with a variety of sensor types and their development, structural analysis, statistical modeling, machine learning and pattern recognition, system engineering, 3D physics-based multi-scale models, the inverse problem for models and model updating, and surrogate modeling or digital twins. The vendor shall have a record of collaborative research with multiple organizations and must be amenable to joint publications and presentations when the level of contribution of partners is warranted, and such contribution should be actively encouraged by the vendor. The vendor will encourage an as-yet-undetermined number of students to travel to ERDC facilities during specific periods when school is not in session to conduct research toward the objectives of this agreement alongside ERDC researchers who will provide oversight and facility resources during those times. The student travel and living expenses will be paid for by the vendor from the funds provided in this agreement and

shall be in line with travel limitations and reimbursements as described by the Department of Defense Joint Travel Regulations current at the time of travel or comparable vendor travel standards. The candidates will also be required to submit three (3) quarterly status reports and one (1) annual report each year of the cooperative agreement to provide updates on the implementation of the project.

Government Involvement:
ERDC will participate in and facilitate meetings to discuss current state-of-practice, needs, future vision and goals, and required engineering expertise concerning the any demonstration systems and other infrastructure as needed. ERDC will identify or serve as the liaison with end-users to facilitate identification of the infrastructure assets to which the research goals outlined herein will be applied. ERDC will participate in field data collection efforts as appropriate, will review quarterly status reports, and will provide input to data interpretation for final reports. ERDC researchers will be collaborating partners in the research objectives outlined above (where and when appropriate) and will contribute to the research at a level consistent with co-authorship on articles. ERDC researchers will participate, at some level, in all journal articles, conference proceedings, and presentations that arise because of this research. ERDC will annually facilitate government laboratory space and research oversight for an as-yet-determined number of students to work toward degree-specific goals when school is not in session at ERDC facilities. ERDC will assist in the facilitation of implementation of the technologies developed because of this research at the infrastructure assets identified at the onset of work.

Section III: Eligibility Information

1. Eligible Applicants – This opportunity is restricted to non-federal partners of the Californian Cooperative Ecosystems Study Unit (CESU).

2. Cost Sharing – This action will be 100% funded by USACE.

Section IV: Application and Submission Information – Two Phase Process

Phase I: Submission of a Statement of Interest/Qualifications.

1. Materials Requested for Statement of Interest/Qualifications:
   a. Please provide the following via e-mail attachment to:
      derek.a.howard@usace.army.mil
      (Maximum length: 2 pages, single-spaced 12 pt. font).

      1. Name, Organization and Contact Information

      2. Brief Statement of Qualifications (including):
         • Biographical Sketch,
         • Relevant past projects and clients with brief descriptions of

these projects,
- Staff, faculty, or students available to work on this project and their areas of expertise,
- Any brief description of capabilities to successfully complete the project you may wish to add (e.g., equipment, laboratory facilities, greenhouse facilities, field facilities, etc.).

Note: A proposed budget is NOT requested at this time.

The administrative point of contact is Derek Howard, 601-634-3310; derek.a.howard@usace.army.mil

2. Statement of Interest/Qualifications shall be submitted NO LATER THAN 11 April 2022 5pm CST.

Based on a review of the Statements of Interest received, an investigator or investigators will be invited to move to Phase II which is to prepare a full study proposal. Statements will be evaluated based on the investigator's specific experience and capabilities in areas related to the study requirements.

Phase II: Submission of a complete application package to include a full technical proposal including budget, if invited.

1. Address to Request Application Package
The complete funding opportunity announcement, application forms, and instructions are available for download at Grants.gov.

The administrative point of contact is Derek Howard, 601-634-3310; derek.a.howard@usace.army.mil.

2. Content and Form of Application Submission
All mandatory forms and any applicable optional forms must be completed in accordance with the instructions on the forms and the additional instructions below.
   a. SF 424 R&R - Application for Federal Assistance
   b. Full Technical Proposal – Discussion of the nature and scope of the research and technical approach. Additional information on prior work in this area, descriptions of available equipment, data, and facilities, and resumes of personnel who will be participating in this effort should also be included.
   c. Cost Proposal/Budget – Clear, concise, and accurate cost proposals reflect the offeror's financial plan for accomplishing the effort

contained in the technical proposal. As part of its cost proposal, the offeror shall submit cost element breakdowns in sufficient detail so that a reasonableness determination can be made. The SF 424 Research & Related Budget Form can be used as a guide but is required if you chose to utilize the subaward budget form. The cost breakdown should include the following, if applicable:

1. Direct Labor: Direct labor should be detailed by level of effort (i.e., numbers of hours, etc.) of each labor category and the applicable labor rate. The source of labor rates shall be identified and verified. If rates are estimated, please provide the historical based used and clearly identify all escalation applied to derive the proposed rates.

2. Fringe Benefit Rates: The source of fringe benefit rate shall be identified and verified.

3. Travel: Travel costs must include a purpose and breakdown per trip to include destination, number of travelers, and duration.

4. Materials/Equipment: List all material/equipment items by type and kind with associated costs and advise if the costs are based on vendor quotes and/or engineering estimates; provide copies of vendor quotes and/or catalog pricing data.

5. Subrecipient costs: Submit all subrecipient proposals and analyses. Provide the method of selection used to determine the subrecipient.

6. Tuition: Provide details and verification for any tuition amounts proposed.

7. Indirect Costs: Currently the negotiated indirect rate for awards through the CESU is 17.5%.

8. Any other proposed costs: The source should be identified and verified.

3. Application package shall be submitted NO LATER THAN 14 May 2022 5pm CST.

4. Submission Instructions

Applications may be submitted by e-mail or Grants.gov. Choose ONE of the following submission methods:

> a. E-mail:
> Format all documents to print on Letter (8 ½ x 11") paper. E-mail proposal to derek.a.howard@usace.army.mil
>
> b. Grants.gov: https://www.grants.gov/:
> Applicants are not required to submit proposals through Grants.gov. However, if applications are submitted via the internet, applicants are responsible for ensuring that their Grants.gov proposal submission is received in its entirety.
>
> All applicants choosing to use Grants.gov to submit proposals must be registered and have and account with Grants.gov. It may take up to three weeks to complete Grants.gov registration. For more information on registration, go to https://www.grants.gov/web/grants/applicants.html.

Section V: Application Review Information

1. **Peer or Scientific Review Criteria:** In accordance with DoDGARs 22.315(c), an impartial peer review will be conducted. Subject to funding availability, all proposals will be reviewed using the criteria listed below (technical andcost/price). All proposals will be evaluated under the following two criteria which are of descending importance.

    a. **Technical (items i. and ii. are of equal importance):**
      i. Technical merits of proposed R&D.
      ii. Potential relationship of proposed R&D to DoD missions.

    b. **Cost/Price:** Overall realism of the proposed costs will be evaluated.

2. **Review and Selection Process**
    a. **Categories:** Based on the Peer or Scientific Review, proposals will be categorized as Selectable or Not Selectable (see definitions below). The selection of the source for award will be based on the Peer or Scientific Review, as well as importance to agency programs and funding availability.

    i. **Selectable:** Proposals are recommended for acceptance if sufficient funding is available.

    ii. **Not Selectable:** Even if sufficient funding existed, the proposal should

not be funded.

Note: The Government reserves the right to award some, all, or none of proposals. When the Government elects to award only a part of a proposal, the selected part may be categorized as Selectable, though the proposal may not merit such a categorization.

b. No other criteria will be used.

c. Prior to award of a potentially successful offer, the Grants Officer will make a determination regarding price reasonableness.

Section VI: Award Administration Information

1. Award Notices
    Written notice of award will be given in conjunction with issuance of a cooperative agreement signed by a Grants Officer. The cooperative agreement will contain the effective date of the agreement, the period of performance, funding information, and all terms and conditions. The recipient is required to sign and return the document before work under the agreement commences. **Work described in this announcement SHALL NOT begin without prior authorization from a Grants Officer.**

2. Administrative Requirements
    The cooperative agreement issued as a result of this announcement is subject to the administrative requirements in 2 CFR Subtitle A; 2 CFR Subtitle B, Ch. XI, Part 1103; and 32 CFR Subchapter C, except Parts 32 and 33.

3. Reporting
    See 2 CFR Sections 200.327 for financial reporting requirements, 200.328 for performance reporting requirements, and 200.329 for real property reporting requirements.

Section VII: Agency Contact

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