NASA IV&V Request for Proposals for Research Program

A. Introduction

The National Aeronautics and Space Administration (NASA) Independent Verification & Validation (IV&V) Program, in collaboration with the NASA WV Space Grant Consortium (WVSGC), solicits proposals for conducting research to advance the primary mission of the IV & V Program in the science of software engineering to improve the safety, quality, reliability, cost, and performance of NASA software systems and related areas, as listed below.

Software Independent Verification and Validation (IV & V) is a system engineering process employing rigorous methodologies for evaluating the correctness and quality of the software product throughout the software life cycle. Verification processes determine whether or not the products of a given software development activity conform to the requirements established for the activity. Validation processes evaluate the software throughout the life cycle to determine whether or not the software satisfies its intended use and user needs.

The NASA IV & V Program is the NASA agent for the development and application of independent verification and validation processes and technology to improve reliability and reduce the risk of software systems. Software IV &V has been demonstrated to be an effective technique on large, complex software systems to increase the probability of software being delivered that meets requirements and is safe, within the cost, and within schedule. When performed in parallel with the development lifecycle, software IV & V provides for the early detection and identification of risk elements, which allows the program to take action to mitigate these risks early in the life cycle. The IV & V Program performs verification and validation on mission-critical software across NASA directorates, missions, and projects.

Each funded proposal is expected to increase the understanding, assessment, development, and utilization of software IV & V, to promote partnerships and cooperation among universities and aerospace industries and to provide hands-on student-involvement opportunities in Science, Technology, Engineering, and Math (STEM) disciplines.

B. Eligibility

Proposals will be accepted from full-time faculty and researchers employed by institutions of higher education in West Virginia. The Principal Investigator (PI) and other personnel, including students, associated with the proposed project must be U.S. Citizens. Duration of each project is one year, and the proposal should include a timeline for the achievement of significant milestones.

C. Proposal Format

Research Description: Provide a summary of the proposed research using no more than five single-spaced pages. The proposal text must be typed in font size 12. Clearly state the objectives and significance of the project, the approach to be used to achieve the objectives and the specific outcomes and deliverables that can be considered as project results.

Budget: Provide a one-page budget sheet describing the project costs and appropriate justifications. NASA funds cannot be used to purchase equipment or for foreign travel. Please include all applicable fringe benefits charges. F & A charges will be applied accordingly once a project has

been approved for funding.

Appendices: Appendices should include at least a one-page résumé of the investigator(s). Other supportive information can be included but should not exceed five pages.

D. Research Areas

Research areas will be identified as topics that are of immediate interest to the IV & V Program. However, proposals that address other aspects of the mission of the IV & V Program will also be considered. A current list of research focus areas of the IV & V Program is attached to this announcement.

E. Funds

Each proposal may request up to $60,000, excluding all F & A charges by the home institution as well as possible subcontract charges, and salary and fringe benefit for the personnel. Purchase of equipment is not allowed under this grant program

F. Evaluation Criteria

Technical and Scientific Merit (30 points)
Relevance to the IV & V Programs Research Priorities (30 points)
Potential for Future Funding and Long-Term Impact (20 points)
The soundness of the Budget (10 points)
Qualifications of the Proposing Team (10 points)

G. Schedule

Proposal due date: Monday, July 1, 2019, by 11:59 PM (EST)
Awards announcement date: July 31, 2019
Anticipated project start date: August 15, 2019
Project duration: One year
Proposals must be submitted online only. Proposals received after the deadline will not be considered. All submissions must be sent by email to Ms. Candy Cordwell at Candy.Cordwell@mail.wvu.edu

H. Inquiries

Technical questions about this solicitation may be directed to:
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NASA IV&V Program
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Inquiries regarding the submission of proposal materials may be addressed to:

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NASA IV & V Program

Research Focus Areas

1. **Application of Formal Methods on Safety-Critical Software Systems**
   NASA is interested in the application of formal methods to assure the safety, security, and dependability of mission-critical software systems. The NASA IV&V Program is seeking research proposals that explore the viability and effectiveness of applying formal methods in a software Independent Verification and Validation (IV&V) setting where high analytical rigor and high fidelity results are essential for assuring highly complex, embedded, safety-critical software systems. NASA is particularly interested in research that focuses on the exploration of formal methods that are aimed at providing increased confidence in early lifecycle software development products and are not limited to software implementation.

2. **Assuring Safety-Critical Autonomous Software Systems**
   The NASA IV&V Program is interested in research that focuses on approaches and tools required to assure safety-critical autonomous software systems. The Gateway (spaceship that will orbit the Moon) and the initiative to send astronauts to the Moon by 2024 will require the use of intelligent autonomous systems. These autonomous systems may include components for executing actions and making decisions and are able to reason about the operating environment and the system itself. The NASA IV&V Program is seeking research proposals to expand its capabilities to provide confidence in these safety-critical autonomous software systems.

3. **Development of Techniques for Constructing Resilient Software Systems**
   The NASA IV&V Program is seeking proposals to evaluate ways to develop and ensure flight software systems are more resilient to both hazards in general but also cyber-attacks that are aimed at disrupting operations or permanently harm or disable a spacecraft. In this context, resiliency is distinct from fault tolerance. Researchers shall define what a resilient spacecraft software is, how resiliency can be achieved, how to assess resiliency, and the factors working against resiliency.

4. **Exploration of Techniques for Evaluating Binary Code**
   The NASA IV&V Program is interested in research proposals to expand its analysis techniques and tools to evaluate binary code. In some situations, flight software may contain Commercial Off-The-Shelf (COTS) or other code in binary form. Decompiling or reverse engineering a binary source code might be necessary to support verification and validation of design or test artifacts. For example, a binary analysis may help to assess code path or specific portions of code for security vulnerabilities.

5. **Data Analytics for Assessing System Risks**
   IV&V projects use a Follow-the-Risk (FTR) approach to better understand and identify areas of risk within the project, capabilities, and software and to focus the IV&V effort in the areas of highest risk. The goal of the FTR approach is to reduce residual risk across the entire risk landscape, regardless of whether or not those risks are part of the original focus

of work. The NASA IV&V Program is interested in advancing its capabilities in software risk analysis and prediction of defects in software. The NASA IV&V Program has access to over 25 years of knowledge/information based upon 25+ years of performing IV&V on NASA missions. This information includes IV&V issues (aka "TIMs"), risks, assurances provided, top-10 issues, methods/approaches used to identify a specific issue, etc. The NASA IV&V Program is interested in research proposals to deduce value from the historical data and to identify ways to uncover new "knowledge" that might help enhance or complement the current FTR methodology.