NASA SBIR 2019 Phase I Solicitation

S5.04 Integrated Science Mission Modeling

Lead Center: JPL

Participating Center(s): GSFC

Technology Area: TA11 Modeling, Simulation, Information Technology and Processing

Innovative System Modeling Methods and Tools

Several concept/feasibility studies for potential large (flagship) Astrophysics missions are in progress: Large UV Optical Infrared Surveyor (LUVOIR), Origins Space Telescope (OST), Habitable Exoplanet Observatory (HabEx), and Lynx. Following the 2020 Astrophysics decadal rankings, one of these will likely proceed to early Phase A where the infusion of new and advanced systems modeling tools and methods would be a potential game-changer in terms of rapidly navigating architecture trades, requirements development and flow-down, and design optimization.

A variety of Planetary missions require significant modeling and simulation across a variety of possible trade spaces. The portions of this topic area focused on breadth and variable fidelity will support them.

NASA seeks innovative systems modeling methods and tools addressing the following needs:

Define, design, develop, and execute future science missions, by developing and utilizing advanced methods and tools that empower more comprehensive, broader, and deeper system and subsystem modeling, while enabling these models to be developed earlier in the lifecycle. The capabilities should also allow for easier integration of disparate model types and be compatible with current agile design processes. They should enable disciplined system analysis for the design of future missions, including modeling of decision support for those missions and integrated models of technical and programmatic aspects of future missions. Similarly, they should enable evaluation of technology alternatives and impacts, science valuation methods, and programmatic and/or architectural trades.

Proposers are encouraged to address more than one of these areas with an approach that emphasizes integration with others on the list.   Specific areas of interest are listed below:

- Conceptual phase models and tools that allow design teams to easily develop, populate, and visualize very broad, multidimensional trade spaces; methods for characterizing and selecting optimum candidates from those trade spaces, particularly at the architectural level. There is specific interest in models and tools that facilitate comprehensive comparison of architectural variants of systems.
- Capabilities for rapid generation of models of function or behavior of complex systems, at either the system or the subsystem level. Such models should be capable of eliciting robust estimates of system performance given appropriate environments and activity timelines, and should be tailored:

- To support design efforts at the conceptual and preliminary design phases, while being compatible with transition to later phases.
- To operate within highly distributed, collaborative design environments, where models and/or infrastructure that support/encourage designers are geographically separated (including Open Innovation environments). This includes considerations associated with near-real-time (concurrent?) collaboration processes and associated model integration and configuration management practices.
- To be capable of execution at variable levels of fidelity. Ideally, models should have the ability to quickly adjust fidelity to match the requirements of the simulation (e.g., from broad-and-shallow to in-depth and back again).
- To provide cutting-edge methodologies for quantifying, characterizing, tracing, and managing uncertainty in computational and real-world systems.

- Target models (e.g., phenomenological or geophysical models) that represent planetary surfaces, interiors, atmospheres, etc. and associated tools and methods that allow for integration into system design/process models for simulation of instrument responses. These models may be algorithmic or numeric but should be useful to designers wishing to optimize systems remote sensing of those planets.

At the completion of Phase II, a working prototype that is suitable for demonstrations with "real" data to make a compelling case for NASA usage is desired.

Expected TRL for this project is 3 to 5.

References:

- LUVOIR: https://asd.gsfc.nasa.gov/luvoir/
- OST: https://asd.gsfc.nasa.gov/firs/
- HabEx: https://www.jpl.nasa.gov/habex/
- Lynx: https://wwwastro.msfc.nasa.gov/lynx/
- https://mars.nasa.gov/programmissions/
- https://www.jpl.nasa.gov/missions/

Note that this sub-topic area addresses a broad potential range of science mission-oriented modeling tools and methods. While we are interested in the integration of these tools into broader model-based engineering frameworks, proposals with MBSE/SysML as the primary focus are encouraged to propose to H6.04 (“Model Based Systems Engineering for Distributed Development” a new FY19 sub-topic area) instead.