<u>Request for Information</u>

Analysis Tools for Textile Composites

Woven TPS (WTPS) and ADEPT Projects

National Aeronautics and
Space Administration

Ames Research Center
Moffett Field, Ca 94035-0001

1.0 INTRODUCTION AND BACKGROUND

The goal of NASA's Office of the Chief Technologist (OCT) is to create the new technological capabilities for science, exploration, and the nation's economic future. Space Technology focuses not only on the technological advances required for NASA's future missions in science and exploration, but also on providing space technologies that can improve the capabilities and lower the cost of other government and commercial space activities. The activities supported by the OCT are summarized on the OCT website (http://www.nasa.gov/offices/oct/).

The Game Changing Development (GCD) Program within OCT, determines the feasibility of novel ideas and approaches that have the potential to revolutionize future space missions.

The GCD Program identifies and rapidly matures technologies from across NASA, academia, industry and other government agencies. The program focuses on taking technologies from proof of concept through component testing by investing in specific technology areas along the following themes:

- Safe and Reliable Human Exploration
- Intelligent Space Operations
- Advanced Materials, Structures, and Manufacturing
- Affordable Space Exploration
- Revolutionary Robotic Systems
- Advanced Measurement, Navigation, and Communication Systems
- Future Energy Systems.

The GCD Program is currently supporting two efforts that are employing textile-derived materials.

1. The Adaptable, Deployable Entry and Placement Technology (ADEPT), which is a mechanically deployable low ballistic coefficient entry system that uses a 3-D woven skin.
2. The Woven TPS (WTPS) project, which uses precisely engineered 3D weaving techniques to customize material characteristics needed to meet specific mission requirements for protecting space vehicles from the intense heat generated during atmospheric entry. It is envisioned that WTPS materials could be used in the dry woven form (without a polymer matrix) or with a polymer matrix infused into the woven substrate.

The use of modeling, design, and manufacturing tools to optimize material properties and performance by the accurate placement of fibers is critical for efficient Woven TPS development. The ability to predict the properties and performance of a woven material, a priori, should reduce the overall testing requirements, resulting in reduced cost and schedule.

To date, substantial effort has been dedicated to tool development for laminate composites; however textile composites are relatively new materials and their mechanisms of failure are very different from traditional laminates. The use of analysis tools to not only predict performance but also evaluate events that lead to failure are important in advancing woven concepts for TPS applications.

The focus of this Request for Information is to assess the state of the art in property prediction tools applicable to 3-D textile derived composites including:

- Thermal property prediction tools
- Mechanical property prediction tools
- Ablation prediction tools
- Failure Mechanisms

The tools and methodology could be applicable to resin infiltrated systems, dry woven systems or both. We will be evaluating and pursuing tool development in the future for both dry woven and resin infused systems.

2.0 SCOPE AND TECHNICAL OBJECTIVE

Responses to this RFI should address the specific questions outlined below, as applicable to your capabilities:

1. What is your current capability in models and computer codes for predicting the properties of 3-D textile composites including (a) thermal, (b) mechanical and (c) ablation? Provide sufficient detail on what properties are modeled (elastic constants, non-linear stress-strain behavior, strength, properties under combined loading, thermal expansion, thermal conductivity, recession, properties as a function of temperature, failure)
2. How does your model represent the geometry of the 3-D textile material?
3. For each model what input data is required?
4. Does the software account for features that are present in real woven materials vs geometrical models, for example ability of tows to deform and increase fiber volume fraction, crimp, yarn twist and waviness etc?
5. What types of fibers/yarns can your model accommodate (carbon, ceramic, polymer) etc?
6. Do you have fiber/yarn property databases available that you can leverage? (provide a list of which fiber/yarn systems you have a database for)
7. What are the limitations of your current tools with reference to the properties listed in Question #1 and do you have any plan/effort to improve these limitations?
8. Do you have the capability to predict properties of woven systems without a matrix component present?
9. Do you have experimental validation data to support any/all tools?
10. Can you provide and references or reports detailing the validation comparisons?
11. Do you have the capability to model permeability and porosity in a woven

substrate?

12. Can you provide some details on the codes, such as sample input and output files?
13. Are user's guides available?
14. Is the software commercially available?
15. What computer and operating system platforms do the software tools run on (Linux, Windows, Mac)? Are there any non-standard hardware or software requirements for the platforms? Do the software tools require additional, third-party tools, such as CAD software to create weave geometry models.

4.0 FORMAT

Electronic format (Microsoft® Word or Adobe PDF)

5.0 ADDITIONAL INFORMATION

All notices pertaining to this RFI will be posted at the NASA Ames Research Center (ARC) Procurement website at:

http://server-mpo.arc.nasa.gov/Services/Proc/home.tml

Interested firms are requested to submit their capability statements and responses to the questions in Section 3.0 above, as well as any comments on the acquisition approach via email to the Contracting Officer,

Marianne.Shelley@nasa.gov

no later than the date and time indicated in the synopsis at the ARC procurement website. Please indicate your company's business size (large business, small business, veteran-owned small business, service-disabled veteran-owned small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns).

This preliminary information is being made available for planning purposes only, subject to FAR Clause 52.215-3, entitled "Request for Information or Solicitation for Planning Purposes." This is a request for information only and does not constitute a commitment, implied or otherwise, that NASA Ames Research Center (ARC) will take procurement action in this matter. Further, neither NASA ARC nor the Government will be responsible for any cost incurred in furnishing this information. NASA ARC is issuing this RFI to gain a better understanding of industry capabilities and to assess the current state of the technology.

Detailed requirements for a future acquisition have not been finalized, nor have the specifics for the acquisition strategy been determined. NASA intends to use the results of this market research to aid in the making of these final decisions. Any future

procurement resulting from this RFI is contingent upon the availability of appropriated funds.

The current materials under development are considered Government sensitive information and information learned about them is not to be disclosed or used for private purpose without prior arrangement with the Government.

Although all comments received in this RFI will be carefully reviewed and considered for inclusion in a later action, the initiators of this request make no commitment to include any particular recommendations.

Following this initial feedback, NASA may conduct one-on-one meetings with potential contractors. These meetings will allow for exchange of information and will provide an opportunity for potential offerors to provide feedback on the Government's requirements and its acquisition approach.

All information received in response to this RFI that is marked "Proprietary" will be handled and protected accordingly. As applicable, NASA may provide Proprietary information to its support service contractors who are under an obligation to keep third-party Proprietary information in confidence. By submitting a response to this RFI, the responder is deemed to have consented to release of Proprietary information to such NASA support service contractors.