NASA SBIR 2017 Phase I Solicitation

Z7.02 Deployable 3D Woven Thermal Protection Materials

Lead Center: ARC

Technology Area: TA9 Entry, Descent and Landing Systems

Large scale mechanically deployed decelerator skirts are expected to experience 50-100 W/cm^2 in various planetary oxidizing environments and are currently designed using flat panels of 3-D woven carbon fibers with sacrificial ablating outer layers over structural layers. The flat panels currently require cutting and joining at each structural rib.

Technologies Sought Include:

- Advancements are sought in weaving carbon fabric-based decelerator skirts that minimize stitched joints (maximum of 1 stitched joint) through the use of polar weaving or spider weave based designs. The weave thickness should be ~0.1 inches with a finished skirt diameter in the 1-3 meter range.
- Development of alternate 3D weave architectures that utilize multiple fiber types, including but not limited to non-ablating fibers on the outer mold line side that transition to structural and/or insulating fiber types. Development of such a capability could provide significant mass savings and performance benefits over pure carbon fiber-based fabric designs.
- Fabric joint development. Improvements are sought in the design of high temperature capable, stitched structural joints to improve post heated failure loads while minimizing conductive heat transfer into underlying deployable structure elements.
- Advancements in integrating 3D features into woven carbon fabrics to reduce manufacture and integration complexity. Examples include incorporation of rounded trailing edge radii into acreage material such that a trailing edge radius is 2-4x the acreage thickness without requiring multiple piece parts and stitching.

For all above technologies, research should be conducted to demonstrate technical feasibility and design during Phase I and show a path towards Phase II demonstration with delivery of a ~1-m diameter demonstration unit for NASA evaluation at the completion of the Phase II contract.