AAE SPECIAL SEMINAR

Ceramic Matrix Composite (CMC) Thermal Protection Systems (TPS) and Hot Structures for Hypersonic Vehicles

TUESDAY FEBRUARY 27TH, 2024
RHPH 172 3:30PM-4:20PM

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Abstract
Thermal protection systems (TPS) and hot structures are required for a range of hypersonic vehicles ranging from ballistic reentry to hypersonic cruise vehicles, both within Earth's atmosphere and non-Earth atmospheres. The focus of this presentation is on air breathing hypersonic vehicles in the Earth's atmosphere. This includes single-stage to orbit (SSTO) and two-stage to orbit (TSTO) accelerators, access to space vehicles, and hypersonic cruise vehicles. The presentation will include a brief discussion of aerodynamic heating and thermal management techniques to address the high heating, followed by an overview of TPS for rocket-launched and air-breathing vehicles. The argument is presented that as we move from rocket-based vehicles to air-breathing vehicles, we need to move away from the "insulated airplane' approach used on the Space Shuttle Orbiter to a wide range of TPS and hot structure approaches. The primary portion of this talk will discuss issues and design options for CMC based TPS and hot structure components, including leading edges, acreage TPS, and control surfaces. The current state-of-the-art will be briefly discussed for some of the components. Environmental durability and technical challenges impacting the use of CMC TPS and hot structures for hypersonic vehicles will be discussed briefly.

Biography

Dr. Glass began his career at NASA Langley Research Center in 1988 and spent most of his career focused on thermal, structural, and material aspects of hypersonic vehicles. He has made significant contributions to many of the US hypersonic demonstrators over the past 30 years. Most of his effort has focused on refractory composite hot structures, utilizing carbon/carbon (C/C) and ceramic matrix composites (CMCs) for hot airframe structural components such as leading edges and control surfaces. He is recognized nationally and internationally as a leader in the area of hot structures for hypersonic vehicles.

As the Senior Researcher for Advanced Structural/Thermal Systems, Dr. Glass is a technical leader in the development and application of highly advanced technologies for the assessment of structural and/or thermal performance of advanced air, space transportation, and planetary entry vehicles. The studies he performs represent major contributions to the Agency's goal to provide world-class capability to more accurately and more rapidly predict structural performance and temperature characteristics for advanced aerospace structural concepts. Prior to his current role, Dr. Glass led the development of a heat-pipe-cooled leading edge for the National AeroSpace Plane, and a led NASA team overseeing the development of the carbon/carbon leading edges for the Hyper-X Mach 10 flight vehicle. Those leading edges helped enable a successful flight in November 2004, setting a world record for the fastest airbreathing airplane. He also led a "Tiger Team" for the development and testing of a small area repair for the Space Shuttle Return to Flight after the Columbia accident. He led a multi-disciplined effort for two NASA programs with a focus on airframe technology development for reusable launch vehicles. He is internationally recognized for his research on hot structures for hypersonic vehicles and has been an invited lecturer on the topic both domestically and internationally. Dr. Glass has numerous publications in the area of hot structures for hypersonic vehicles, including several book chapters, and continues to serve as a resource for multiple government and industry organizations in the area of hot structures for hypersonic vehicles. In addition, he has mentored over 50 undergraduate and graduate student interns at NASA Langley and is the recipient of NASA's Distinguished Service Medal.