

Topic 1: Thermal Protection & Management Systems

This session includes all aspects of thermal protection systems (TPS) design to include active and passive approaches, analysis, and manufacturing that support ballistic, airbreathing, boost-glide, and re-entry systems for military applications. Program and system overviews with pertinent materials, issues, and updates related to current programs are also included. Focus areas include:

- Design and ground/flight testing of thermal protection systems concept or components;
- Thermal management of subsystems including active & passive technologies;
- Novel Instrumentation or applications to support TPS development;
- Emerging and innovative materials for TPS applications;
- Oxidation/ablation modeling and test;
- Erosion modeling and test;
- Thermostructural modeling, material properties, and testing;
- Advanced and additive manufacturing methods of TPS elements; and
- Nosetips and leading edges.

Topic 2: Propulsion

This session addresses propulsion concepts that support hypersonic flight and responsive strike systems. Three main areas of interest include solid rocket motors, air-breathing propulsion, and small solid stage motors with responsive solutions for end game maneuverability. While concept development phase activities are of interest, consideration will be given to elevated TRLs/MRLs where ground and flight test data from prototype propulsion components and systems are available.

Rocket Motor Areas of Interest Include:

- Booster motors/booster systems with multiple stages demonstrated via ground testing;
- Nozzle and thrust vectoring systems;
- Air launch design technologies;
- Divert and Attitude Control Systems (DACs);

Air-Breathing Propulsion Areas of Interest Include:

- Scramjet system and engine development programs;
- Engine material technologies; and
- Flow path M&S with validation.

Topic 3: Aerodynamics & Aerothermodynamics

Aerodynamics and aerothermodynamics play a significant role in the design of hypersonic systems, driving flight vehicle performance and robustness. These phenomena must be adequately characterized with uncertainties identified to develop guidance and control methodologies. Due to the unique challenges associated with hypersonic flight coupling of the aerodynamic and aerothermodynamic environments, advanced modeling and simulation approaches, validated by ground/flight test and evaluation, are required. The HTSC Aerodynamics and Aerothermodynamics session will address the challenges and on-going investments in hypersonic system technology maturation.

Topic 4: Navigation, Guidance & Control

Hypersonic systems offer enabling capability to counter adversarial threats and provide the U.S. with significant advantages to address both offensive and defensive requirements. However, deviations from historical aerodynamic configurations and re-entry environmental challenges require technology maturation in Navigation, Guidance & Control (NG&C) to support hypersonic flight systems. This session

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will focus on addressing these requirements for current and future configurations of interest within the hypersonic community. Topics of interest include:

- Challenges associated with hypersonic flight systems related to NG&C and electrical systems;
- Auto-pilot design and implementation for hypersonic systems and platforms;
- Navigation and guidance in GPS-contested environments;
- Tactical/strategic navigation systems;
- M-Code and hypersonic-specific code and algorithm implementation;
- Unique control system technology development and maturation for moderate to high lift/drag ratio vehicles;
- Uncertainty analysis and contributors for NG&C systems;
- Integration between NG&C, aerodynamic, aerothermodynamic, and power system simulation methods and analyses.

Topic 5: Programmatic Review

Hypersonic R&D and flight system programs are being conducted by each of the services and agencies such as the Office of the Secretary of Defense, Defense Advanced Research Projects Agency, and the Strategic Capabilities Office. Each organization working on hypersonics brings unique skills and capabilities. Ground, air, or sea launch are examples of system differences while areas such as shape, range, size, and other key areas are vehicle unique design challenges. The program review session will focus on discussions related to current status and path forward for specific service and agency hypersonics programs.

Topic 6: Defense Against Hypersonic Systems

Hypersonic threats present a unique challenge to U.S. defensive systems. They operate at high velocity, are capable of high acceleration maneuvers, operate across a large range of altitudes, and do not have a predictable trajectory. This session will examine the applicability of current and future defensive systems against the hypersonic threat. The Defensive Systems topic area is devoted to generation of key knowledge points, including modeling and simulation, to mature a defense against hypersonic systems that may include:

- Architecture concepts studies;
- Sensor / shooter interactions;
- Battle management and CONOPS;
- All aspects of the threat kill chain (detect, track, engage, assess);
- Survivability of the defensive system;
- Determination of lethality (hard or soft kills); and
- Technical challenges of the mission.

Topic 7: Detecting & Tracking Hypersonic Objects

This session will examine technologies and capabilities for detecting, countering the operation, and counter detection of hypersonic objects. There is a need to develop the capabilities to detect and defeat the adversaries' hypersonic threats in different flight scenarios. This topic area is devoted to examining possible detection techniques associated with the hypersonic dynamics and flight environment effects, as well as the possible techniques to counter such detection. For example, analysis and characterization of target, as well as clutter produced due to the presence of different types of density irregularities inside the flow around a hypersonic vehicle could provide valuable insights for new efficient detection and countering capabilities. Combined with technologies and testing associated with achieving hypersonic velocities, presentations may touch on:

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- Modeling, experiments, and phenomenology;
- Interaction and scattering of multispectral beams with wave turbulence;
- Detection of hypersonic objects using specific spatial waveforms;
- Impact on navigation and guidance;
- Other topics specific to detection and countermeasure;
- Target signature effects to include impact of ablation, heating, turbulence; and
- Sensor platform capability and experimental results.

Topic 8: Sensing in a Hypersonic Environment

Existing subsonic missiles have developed terminal sensors to increase accuracy and lethality for both stationary and moving targets. This session will investigate terminal and ISR sensors for a hypersonic system. The high-speed environment adds additional difficulty due to compressed engagement time line, high surface temperature on the sensor window, and limited aperture size. In addition, future capability requirements may drive the need for developing the ability to send and receive multiple signal types and thus require a variety of sensors and windows. Areas of discussion include:

- Sensor trade studies for a hypersonic environment;
- High temperature antennae and window materials;
- Propagation of signals through high temperature materials and flow fields;
- Sensor designs for hypersonic vehicles;
- Ground test facilities for combined hypersonic environment testing related to sensing;
- Modeling and simulation of hypersonic engagements of a moving target; and
- Target discrimination in a time constrained environment.

Topic 9: Ground Test Facilities and Instrumentation

This session will address ground test and evaluation of hypersonic weapon technologies, components, and systems to validate models and support flight system development. Presentations will include those from government, industry, and academia focused on developing and utilizing Government-owned or commercial ground test facilities that address and mature hypersonic systems and technologies.

Topic 10: Systems Engineering and Systems Design

Systems engineering and systems design involves developing and executing multidisciplinary solutions to enable emerging hypersonic platform capabilities, as well as vehicle level integration of subsystems into hypersonic platforms across all mission phases and life cycle. This session will cover multidisciplinary trade study methods to optimize system performance in a highly constrained environment. Specific focus will include, but is not limited to:

- Integration of systems components (flight electronics, ordnance, controls);
- Integration of sensors/windows into heatshields and outer mold lines (OMLs);
- Performance trades with competing weight, range, payload parameters;
- Launch system integration;
- Booster-to-vehicle integration;
- Fluid thermal structural interaction;
- Model based system engineering;
- Affordability & producibility; and
- Reliability & maintainability.

Topic 11: Flight Testing

Hypersonic flight tests have been conducted for several years, the results of which have brought a wealth of data about the characteristics of hypersonic flight. DARPA, DOE, NASA and the defense services have demonstrated various key technological areas using sled tests and wind tunnel tests and have conducted full system flight tests. This session is dedicated to plans, objectives, results, challenges and other items related to hypersonic flight testing. Explore new ways to do flight tests in a resource and schedule constrained environments. Topics such as accuracy, maneuvers, thermal protection capabilities, range infrastructure, flight termination, diagnostics, measurements, communications, security and capabilities will also be addressed. The ultimate goal is to share knowledge and plans of hypersonic flight testing and determine where knowledge and efforts can be leveraged.

Topic 12: Mission Planning & C4ISR

The ability to employ hypersonic systems (offense and defensive) on time-sensitive and critical targets is of extreme importance to the DoD. This session will examine various capabilities and the technologies related to: testing, ISR, targeting, command and control, communication and decision making as it applies to employing hypersonic capabilities. Areas of discussion include:

- Compressing the kill chain to reduce our adversaries' decision time;
- Energy management and trajectory optimization with vehicle constraints;
- ISR, target and identification;
- Mission and flight planning;
- Decision making;
- Defensive and survivability constraints and endgame lethality