**Abstract for 42th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit on Numerical Propulsion System Simulation (NPSS)**

The NASA Glenn Research Center, in partnership with the aerospace industry, other government agencies, and academia, is leading the effort to develop an advanced multidisciplinary analysis environment for aerospace propulsion systems called the Numerical Propulsion System Simulation (NPSS). NPSS is a framework for performing analysis of complex systems. The initial development of NPSS focused on the analysis and design of airbreathing aircraft engines, but the resulting NPSS framework may be applied to any system, for example: aerospace, rockets, hypersonics, power and propulsion, fuel cells, ground based power, and even human system modeling. NPSS provides increased flexibility for the user, which reduces the total development time and cost. It is currently being extended to support the NASA Aeronautics Research Mission Directorate Fundamental Aeronautics Program and the Advanced Virtual Engine Test Cell (AVETeC). NPSS focuses on the integration of multiple disciplines such as aerodynamics, structure, and heat transfer with numerical zooming on component codes. Zooming is the coupling of analyses at various levels of detail. NPSS development includes capabilities to facilitate collaborative engineering. The NPSS will provide improved tools to develop custom components and to use capability for zooming to higher fidelity codes, coupling to multidiscipline codes, transmitting secure data, and distributing simulations across different platforms. These powerful capabilities extend NPSS from a zero-dimensional simulation tool to a multi-fidelity, multidiscipline system-level simulation tool for the full development life cycle.
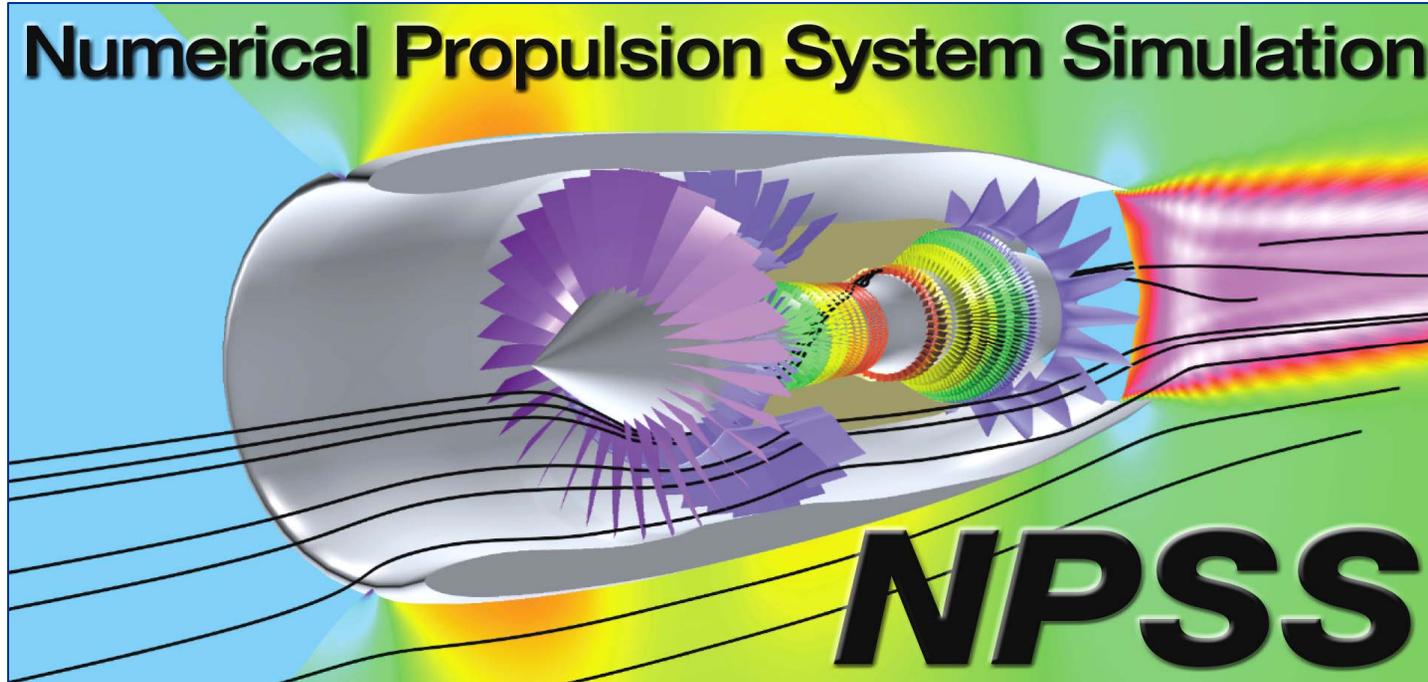
42nd AIAA/ASME/SAE/ASEE
Joint Propulsion Conference & Exhibit

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Agenda

- **Brief Status**

- **NPSS Usage and Possible Future Enhancements**
    - Air Force Research Lab   (Nick Kuprowicz)
    - University of Maryland   (Josh Clough)
    - MIT & Georgia Tech   (Ian Waitz & Jimmy Tai)
    - Aerojet   (Tim O'Brien)
    - Pratt&Whitney   (Steve Sirica)
    - GE Aircraft Engines   (Ron Plybon)
    - NASA GRC   (Tom Lavelle)

- **Discussion**
- **Closing Remarks**

NPSS
Vision & Objective

- Vision: Create a "Numerical Test Cell" enabling complete aerospace propulsion simulations overnight on cost-effective platforms.

- Product Objective: Provide a common tool and extensible framework to enable rapid, high-confidence, cost efficient design of aerospace systems.

Background:
Partnerships

- 1997 - Established Space Act Agreement (SAA 3-83) and NASA Industry Cooperative Effort (NICE) Agreement
  - NASA Glenn Research Center at Lewis Field
  - Honeywell
  - Rolls-Royce Corporation (RRC)
  - The Boeing Company
  - Arnold Engineering Development Center (AEDC)
  - Wright Patterson Air Force Base (WPAFB)
  - General Electric Aircraft Engines (GEAE)
  - Pratt & Whitney (P&W)
  - Teledyne Continental Motors-Turbine Engines
  - Williams International (WI)

- 2003 - Established SAA for Commercialization of NPSS V1.X with Wolverine Ventures, Inc. (www.virtualtestcell.com)

- 2006 - Currently working with partners to establish new SAAs with same partners as SAA 3-83, plus Lockheed and Aerojet

NPSS Status

- Funding
  - NASA Aeronautics Research Mission Directorate Fundamental Aeronautics Program
  - Advanced Virtual Engine Test Cell (AVETeC)
- Accomplishments
  - April 2005 NPSS Version 1.6.3 Incremental Release
    - GUI Enhancements, Multi-Fidelity/Multi-Discipline Capabilities, Thermo & Solver Upgrades
  - September 2005 Updated NPSS Release Policy Signed
  - June 2006 NPSS Version 1.6.4 Incremental Release
    - Enhanced to allow the Solver to be loaded through a Dynamically Loadable Module
- Plans
  - Enhance high-fidelity & multi-disciplinary capabilities to realize vision
  - Provide long-term support & availability to users
  - Market NPSS to broader user base

Summary

- NPSS object-oriented architecture has been proven on a wide variety of applications

- Progress towards realizing the NPSS vision continues

- Involving partners throughout the development process is critical & invaluable