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**ABSTRACT INFORMATION**

**Title:** Ares I-X Flight Test Validation of Control Design Tools in the Frequency-Domain

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**MANAGEMENT APPROVAL**

The individual below certifies that the required resources are available to present this paper at the above subject JANNAF meeting.

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**Date:** Oct 6, 2010
A major motivation of the Ares I-X flight test program was to Design for Data, in order to maximize the usefulness of the data recorded in support of Ares I modeling and validation of design and analysis tools. The Design for Data effort was intended to enable good post-flight characterizations of the flight control system, the vehicle structural dynamics, and also the aerodynamic characteristics of the vehicle. To extract the necessary data from the system during flight, a set of small predetermined Programmed Test Inputs (PTIs) was injected directly into the TVC signal. These PTIs were designed to excite the necessary vehicle dynamics while exhibiting a minimal impact on loads. The method is similar to common approaches in aircraft flight test programs, but with unique launch vehicle challenges due to rapidly changing states, short duration of flight, a tight flight envelope, and an inability to repeat any test.

This paper documents the validation effort of the stability analysis tools to the flight data which was performed by comparing the post-flight calculated frequency response of the vehicle to the frequency response calculated by the stability analysis tools used to design and analyze the preflight models during the control design effort. The comparison between flight day frequency response and stability tool analysis for flight of the simulated vehicle shows good agreement and provides a high level of confidence in the stability analysis tools for use in any future program. This is true for both a nominal model as well as for dispersed analysis, which shows that the flight day frequency response is enveloped by the vehicle’s preflight uncertainty models.
### Subcommittee/Mission Area Worksheet

The following chart lists each subcommittee and its mission areas. Please choose the subcommittee and mission area that is appropriate for your abstract and mark the abstract form accordingly.

<table>
<thead>
<tr>
<th>Mission Area</th>
<th>JPM</th>
<th>CS</th>
<th>APS</th>
<th>EPSS</th>
<th>PSHS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tactical Propulsion</td>
<td>Guns</td>
<td>Conventional Ramjet Propulsion</td>
<td>Exhaust Plume Flow Field Analysis</td>
<td>Thermal Decomposition and Cookoff</td>
</tr>
<tr>
<td>2</td>
<td>Missile Defense/Strategic Propulsion</td>
<td>Solid Propellants &amp; Combustion</td>
<td>Scramjet Propulsion</td>
<td>Exhaust Plume Radiation</td>
<td>Impact/Shock-Induced Reactions</td>
</tr>
<tr>
<td>3</td>
<td>Propulsion Systems for Space Access</td>
<td>Explosive Performance/ Enhanced Blast</td>
<td>Scramjet Propulsion/Structures</td>
<td>Exhaust Plume Effects</td>
<td>Insensitive Munitions Technology</td>
</tr>
<tr>
<td>4</td>
<td>Gun and Gun-Launched Propulsion</td>
<td>Airbreathing Combustion</td>
<td>Scramjet Component/Engine Testing</td>
<td>Other Exhaust Plume Related Problems</td>
<td>Gun Propellant Vulnerability</td>
</tr>
<tr>
<td>5</td>
<td>Propulsion and Energetics Test Facilities</td>
<td>Combustion Diagnostics</td>
<td>Combined/ Advanced Cycle Propulsion</td>
<td>Signatures and Spectral and In-Band Radiometric Imaging of Targets and Scenes (SPIRITS)</td>
<td>Propulsion Systems Safety and Hazard Classification</td>
</tr>
<tr>
<td>6</td>
<td>Sensors for Propulsion Measurement Applications</td>
<td>Liquid, Hybrid, and Novel Propellants Combustion</td>
<td>Small/Expendable Turbopropulsion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td>Component Modeling and Simulation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>