School of Aeronautics and Astronautics

SYMPOSIUM

The 2014 Research Symposium Series

* Free Pizza *

Monday, April 14, 2014

4:30 pm in ARMS 1021

Combustion Characterization of Amine Borane Hypergolic Propellants

Jared Willits

The development of stable, nontoxic hypergolic propellants will produce more effective, affordable, and sustainable space exploration capabilities. This research investigates green propellants based on ignition delay, characteristic velocity, and predicted specific impulse. Candidates are identified using high speed video through drop tests of oxidizer into a small pool of fuel. Selected samples are further evaluated in a small combustor at pressures up to 200 psia. Optical access of the impinging spray provides qualitative assessment of atomization and ignition. Precision measurements of pressure, nozzle diameter, and piston size and velocity allow determination of characteristic velocity. Findings are compared against the industry standard, monomethylhydrazine and red-fuming nitric acid, measured in the same article for relative performance and against predictions from a NASA combustion code as a measure of combustion efficiency. Across all propellants investigated, the peak efficiency was approximately 75%. Arrays of orifices and nozzles grant the variability to test diverse samples with similar injection parameters such as jet momentum ratio and jet residence time. Rapid iteration within a portfolio of green, high energy-density hypergols can reduce, and ideally eliminate, instability, toxicity, and the performance gap relative to MMH/RFNA currently limiting their implementation.

Vane Wake Characterization for the Purdue 3-Stage Research Compressor

Jeanne Methel

Experimental turbomachinery research requires detailed interrogations of the flow field with many measurement techniques. Similar to CFD, it is often assumed that a single vane passage is representative of all circumferential passages, and thus measurements are acquired from only one passage. However, it is important to evaluate possible differences between passages and understand how they impact data collection. The objective of this project is to characterize the vane passage variability in terms of stator wakes and facilitate future instrumentation placement in the Purdue 3-stage axial research compressor by creating a measurement port database. This compressor features multiple circumferential measurement locations at the exit of each stator row. Stator wakes are measured with total pressure rakes traversed every 2% of each vane passage. Stator wake widths varied from 2.19% to 34.2% and depths from 0.338% to 9.50%, where Stator 2 wakes exhibited the most variation.

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