Experimental Study of Gas-Dynamic Heating in Hartmann-Sprenger Tubes for Rocket Engine Ignition

A Master's Thesis Defense in Mechanical Engineering

California Polytechnic State University, San Luis Obispo

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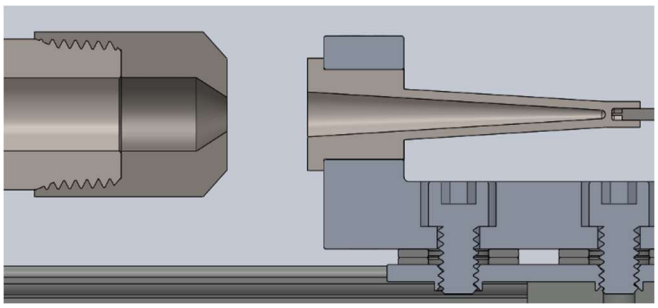

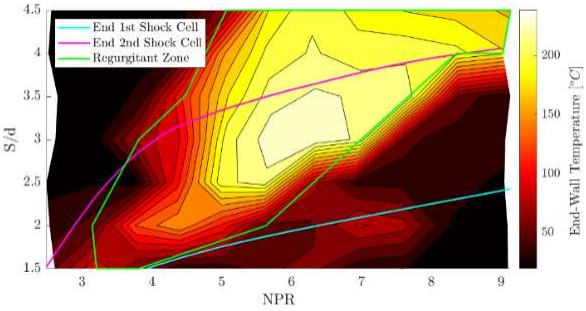

Resonance igniters are a method of igniting rocket engines that rely solely on heating driven by gas-dynamic oscillations to initiate combustion of the rocket propellants. These systems do not require external energy input from chemical or electrical sources, which makes them a potentially less complex alternative to conventional ignition systems. The core component of resonance igniters is the Hartmann-Sprenger Tube (HST), a device which creates and sustains high-frequency gas oscillations through the interaction of a sonic jet of gas and a resonance tube. To advance the development of a functional resonance igniter at Cal Poly, this thesis investigates three parameters that have been observed as primary drivers of heating performance and oscillation behavior in an HST: nozzle pressure ratio, nozzle-cavity spacing, and cavity length. A modular HST apparatus was designed and constructed to enable a parametric survey of these variables and their effects on the oscillations within conical resonance tubes. Three interchangeable resonance tubes were designed with geometry optimized to maximize heating and produce sufficient temperatures for igniting high-performance rocket propellants. Heating trends within the resonance tubes were found to depend strongly on the oscillation mode, with significant variation across geometries and test conditions.

Friday, August 29th, 2025, 11:00am, Held Virtually

Zoom Meeting ID: 574 081 5197 | https://calpoly.zoom.us/j/5740815197