

# Hybrid Approach for Modeling Chemical Kinetics and Turbulence Effects on Combustion- Instability

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Subcontractor: Gloyer-Taylor Laboratories

## Identification and Significance of Innovation

1. Combustion instability poses a significant schedule and cost risk to development of new rocket engines.
2. System level tools for combustion instability analysis exist but the use a simplified representation of many of the relevant processes, e.g., combustion.
3. Develop a tool to incorporate detailed computation of distributed combustion and heat release into an existing combustion instability analysis tool (UCDS).

Estimated TRL (1 – 9) at beginning and end of contract:  
Begin 2- End (4-5)

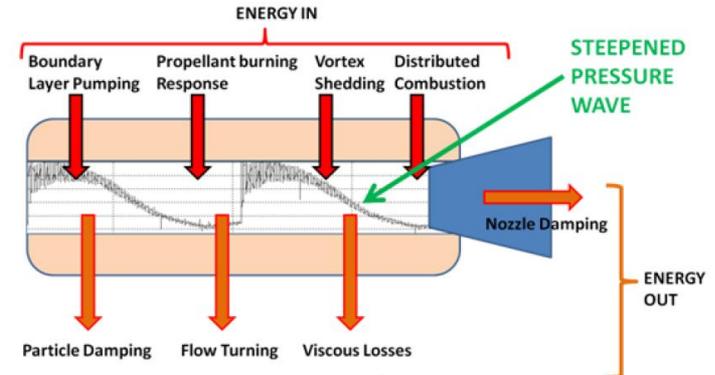


Figure 1: Various Mechanisms Contributing To Build-Up and Dissipation of Combustion Instabilities

## Technical Objectives and Work Plan

1. Perform 2D CFD simulations using both RANS and LES with a range of chemistry models for a single injector combustion chamber.
2. Develop method to integrate CFD results in UCDS process to predict instability characteristics.
3. Characterize importance of detailed chemical kinetics in the instability modes of the combustion chamber.
4. Characterize importance of turbulence-chemistry interactions in the predicting instability modes

## NASA and Non-NASA Applications

- Instability analysis in rocket engines, gas turbine combustors, ramjets and scramjet by NASA, DOD and OEMs.
- The instability analysis tool will be useful to gas turbine manufacturers in gas turbine combustors for civilian energy and aviation applications .
- The software tool developed will allow cost-effective design and analysis of combustion systems with reduced susceptibility to instability.

## Firm Contacts

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