Particle Image Velocimetry Analysis of Turbulent Counterflow Flames in High Pressure Extinction Conditions

(Technical Report)

Regulatory Responses to Technological Innovation in U.S. Civil Aviation

(STS Research Paper)

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by

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Preface

Technical and social factors, including fuel economy, noise pollution, environmental impact, regulatory barriers, public perceptions, and economic inequality, limit the accessibility of civil aviation.

Efficient gas turbine engine design requires high-accuracy computational simulation before full-scale development. High-pressure turbulent flame conditions have been insufficiently characterized for computational modeling. Experimentation to better establish near extinction and extinction limits of high-pressure conditions can support more accurate modeling of experimental combustors for the development of more efficient gas turbine engines. We sought to confirm particle image velocimetry system accuracy (reproduction accuracy of published low-pressure regime flow characterizations) and to collect high-pressure regime turbulent flow characterization at near flame extinction and flame extinction conditions. Turbulent conditions were achieved by varying the bulk flow strain rate and gas density at pressures up to 10 atm. The 2D PIV vector spacing was resolved to 50-micron turbulent eddies, just slightly larger than the Kolmogorov length scales of approximately 15-20 microns. In this project, the expert guidance of Professor Chloe Dedic and the skilled assistance of John (Hogan) Wilder were indispensable.

The Federal Aviation Administration regulates U.S. civil aviation in the public interest. Application of Molk and Rowell's generalized model of regulatory responses to U.S. civil aviation indicated that FAA regulations follow a sinusoidal pattern of regulation and deregulation. In periods of higher regulation, the development and operations of new technologies is stifled, costing growth opportunity, revenue, and jobs.

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