MAE Seminar Series

Numerical Simulations and Experiments of High Speed Fuel Injection for Scramjet Applications

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Baldy 101

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ABSTRACT

Recent flight demonstrations of supersonic combustion ramjet (scramjet) vehicles prove their increasing promise for military (rapid response and strike capability on global scale), aerospace (safer and more affordable access to space), and civil aviation (hypersonic point-to-point transport) applications. Currently, these technologies are still in their early development stages with commercial interest and investment at only a fraction of that of government organizations such as NASA and DoD. To advance hypersonic air-breathing propulsion technologies to the technology readiness levels necessary for access to space or widespread commercialization, further government investments and university engagement are needed over the next decade and likely beyond. This is because designing scramjet propulsion devices capable of robust high-speed air-breathing operation, characterized by rapid fuel and air mixing, short combustion times, and ensuring stable flame, has proven difficult. In this presentation, we will discuss one of the key challenges in high-speed propulsion design, namely the fuel injector design. Attempts at improving fuel injection to enhance fuel-air mixing while simultaneously reducing engine thrust losses have received a great deal of attention over the years. Although some amount of loss is thermodynamically unavoidable and occurs due to the desired effect of molecular mixing, any losses beyond this minimum required amount reduces the thrust potential of the engine. The Enhanced Injection and Mixing Project (EIMP) at NASA Langley Research Center aims at addressing this design challenge by analyzing the performance of a number of baseline and novel fuel injectors for high-speed applications. The project leverages computational and experimental capabilities with the goal to investigate scramjet fuel injection and mixing physics, improve our understanding of the underlying physical process, and develop enhancement strategies relevant to hypersonic flight Mach numbers. The talk will discuss the current computational and experimental research approaches using one of the baseline injectors considered by the EIMP as an example.

BIO SKETCH

Dr. Tomasz (Tom) G. Drozda is an Aerospace Research Scientist at the Hypersonic Airbreathing Propulsion Branch at the NASA Langley Research Center. His expertise lies in the modeling and simulation of reacting flows. Tom graduated from the University at Buffalo with a BS and MS degrees in Mechanical Engineering in 1999 and 2002, respectively. He earned his PhD in Mechanical Engineering from the University of Pittsburgh in 2005. Prior to joining NASA in 2010, Tom worked at the Sandia National Laboratories in Livermore, CA and Rolls-Royce in Indianapolis, IN.

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