Rotating Detonation Engine Research at the University of Maryland

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Rotating detonation engine (RDE) is one of the most promising combustor concepts that can revolutionize the future propulsion and power systems. RDE operates on detonation-based thermodynamic cycles, which can provide substantial design benefits as well as thermodynamic efficiency improvements over the conventional Brayton-cycle engines. Some experimental evidence from RDE testing, however, suggests that many prototype RDEs operate without having the detonation waves fully established inside the combustor under certain operating conditions. At the University of Maryland, we have been using a linear model detonation engine (LMDE) setup to experimentally simulate an unwrapped RDE combustor geometry and to recreate the key flow processes and the physical mechanisms that may occur during RDE operation, including the complex interactions between detonation wave propagation, injector acoustic characteristics, and periodic convection of reacting flows inside the combustor. Various combinations of fuel and oxidizer have been tested, including hydrogen, methane, or ethylene as the fuel, and oxygen or air as the oxidizer. In recent LMDE experiments at the University of Maryland, we have experimentally simulated many different flow conditions that may occur during RDE operations, and have observed some cases with clear decoupling between the lead shock waves and the trailing flames as hypothesized. We have also investigated the transient response of the injector flowfields interacting with detonation waves propagating from one direction over the injectors as well as merging from both directions. In particular, injector refresh behaviors and injector dynamic response characteristics have been systematically measured as a function of incident wave strength and injector flow rates. This presentation will summarize our recent progress at the University of Maryland studying the RDE flowfields and various unit physics problems for better understanding of the physical mechanisms.