Abstract

Interest in detonation-based propulsion systems started due to the theoretical increase in efficiency compared to conventional deflagration-based systems . In the last decade, the Rotating Detonation Engine (RDE) has been a popular area of research within detonation-based engine technology. There are numerous challenges and difficult problems to solve prior to realizing any of the theoretical advantages. One of the key parameters to investigate is fluid injector response time. The response time of the injectors relative to the detonation cycle time is considered to be a limiting factor in stable detonation operation, so injector configuration/geometry is critical when designing a RDE system. Existing RDE test hardware of 6" nominal outer diameter with an Axial Air Inlet (AAI) configuration was modified to include high-frequency pressure transducers. A total of 31 tests were performed in an unheated facility using varying $H_2 - Air$ mixtures across 2 injectors with different air injector throat areas. The operational map was created for the 2 injectors with 17 of the tests producing stable detonation waves. A series of data analysis tools were used to assess a combination of quantitative and qualitative measurements from high-speed video, high-frequency pressure statistics, and high-frequency pressure response curves, all having strong correlations to injector response time. Several trends were identified, with some that agree with literature, and there are data points that can be used to advance the state of the art. Coupling this data with a computational model will be crucial in future work to assist RDE injector design.