2C03: FLUID DYNAMICS OF ROTATING DETONATION ENGINE WITH HYDROGEN AND HYDROCARBON FUELS

Douglas Schwer, K. Kailasanath, Naval Research Laboratory, USA

Rotating detonation engines (RDE's) represent a logical step from pulsed detonation engine concepts to a continuous detonation engine concept for obtaining propulsion from the high efficiency detonation cycle. The hydrogen/air and hydrogen/oxygen RDE concepts have been most extensively studied however, being able to use hydrocarbon fuels is essential for practical RDE's. The current paper extends our hydrogen/air model to hydrocarbon fuels with both air and pure oxygen as the oxidizer. Before beginning the RDE calculations, several detonation tube results are summarized showing the ability of the code to reproduce the correct detonation velocity and CJ properties. In addition, a calculation capturing the expected irregular detonation cell patterns of ethylene/air is also shown. To do the full range of fuels and oxidizers, we found the use of curve-fit thermodynamic properties to be essential, especially for hydrocarbon/oxygen mixtures. The overall results for air-breathing RDE's with hydrocarbons ranged from 1988 to 2537 s, while in pure oxygen mode the specific impulse varied from 699 to 1066 s. These results were between 85–89% of the expected ideal detonation cycle results, and are in line with previous hydrogen/air estimates from our previous work. We conclude from this that hydrocarbon RDE's are viable and that the basic flow-field patterns and behaviors are very similar to the hydrogen/air cases detailed previously.

Douglas Schwer: schwer@lcp.nrl.navy.mil