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Pulse detonation assessment for alternative fuels (Article)

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Abstract

View references (63)

The higher thermodynamic efficiency inherent in a detonation combustion based engine has already led to considerable interest in the development of wave rotor, pulse detonation, and rotating detonation engine configurations as alternative technologies offering improved performance for the next generation of aerospace propulsion systems, but it is now important to consider their emissions also. To assess both performance and emissions, this paper focuses on the feasibility of using alternative fuels in detonation combustion. Thus, the standard aviation fuels Jet-A, Acetylene, Jatropha Bio-synthetic Paraffinic Kerosene, Camelina Bio-synthetic Paraffinic Kerosene, Algal Biofuel, and Microalgae Biofuel are all asessed under detonation combustion conditions. An analytical model accounting for the Rankine-Hugoniot Equation, Rayleigh Line Equation, and Zel'dovich-von Neumann-Doering model, and taking into account single step chemistry and thermophysical properties for a stoichiometric mixture, is applied to a simple detonation tube test case configuration. The computed pressure rise and detonation velocity are shown to be in good agreement with published literature. Additional computations examine the effects of initial pressure, temperature, and mass flux on the physical properties of the flow. The results indicate that alternative fuels require higher initial mass flux and temperature to detonate. The benefits of alternative fuels appear significant. © 2017 by the authors.

Author keywords

Alternative fuels | Biofuels | Pressure-gain combustor | Propulsion | Pulse detonation engine

Indexed keywords

Engineering controlled terms: Aircraft propulsion | Biofuels | Chemical analysis | Combustion | Detonation | Fuels | Kerosene | Propulsion | Pulse detonation engines | Synthetic fuels | Thermodynamic properties

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