World Academy of Science, Engineering and Technology
International Journal of Aerospace and Mechanical Engineering
Vol:18, No:12, 2024

Design and Fabrication of Pulse Detonation Engine Based on Numerical Simulation

Authors : Vishal Shetty, Pranjal Khasnis, Saptarshi Mandal

Abstract : This work explores the design and fabrication of a fundamental pulse detonation engine (PDE) prototype on the basis of pressure and temperature pulse obtained from numerical simulation of the same. PDE is an advanced propulsion system that utilizes detonation waves for thrust generation. PDEs use a fuel-air mixture ignited to create a supersonic detonation wave, resulting in rapid energy release, high pressures, and high temperatures. The operational cycle includes fuel injection, ignition, detonation, exhaust of combustion products, and purging of the chamber for the next cycle. This work presents details of the core operating principles of a PDE, highlighting its potential advantages over traditional jet engines that rely on continuous combustion. The design focuses on a straightforward, valve-controlled system for fuel and oxidizer injection into a detonation tube. The detonation was initiated using an electronically controlled spark plug or similar high-energy ignition source. Following the detonation, a purge valve was employed to expel the combusted gases and prepare the tube for the next cycle. Key considerations for the design include material selection for the detonation tube to withstand the high temperatures and pressures generated during detonation. Fabrication techniques prioritized readily available machining methods to create a functional prototype. This work detailed the testing procedures for verifying the functionality of the PDE prototype. Emphasis was given to the measurement of thrust generation and capturing of pressure data within the detonation tube. The numerical analysis presents performance evaluation and potential areas for future design optimization.

Keywords : pulse detonation engine, ignition, detonation, combustion
Conference Title : ICAAA 2024 : International Conference on Applied Aerodynamics and Aeromechanics
Conference Location : Goa, India
Conference Dates : December 09-10, 2024