Paper ID: 14474
student

SPACE PROPULSION SYMPOSIUM (C4)
New Missions Enabled by New Propulsion Technology and Systems (6)

Author: Mr. simon don
China, simondonxq@gmail.com

Prof. Jian-Ping Wang
China, wangjp@pku.edu.cn

# NUMERICAL STUDY ON ROTATING DETONATION WAVE IN CYLINDER TUBE

**Abstract**

Combustion processes can be divided into two modes: deflagration and detonation. The combustion in conventional engines belongs to deflagration. The propagation velocity of deflagration wave is about several meters per second, while it is about several thousand meters per second for detonation wave propagates in gas mixture. Thus detonation allows more intense and rapid combustion, which means that enormous thrust can be created for a smaller combustor.Based on the above advantages, during the past 60 years or so, there have been numerous research efforts at harnessing the potential of detonations for propulsion applications1.

A rotating detonation engine (RDE) provides an alternative way to apply detonation power. From the preliminary research, it is discovered that a RDE can continuously work. A breakout development may be achieved in detonation engine investigation.

About RDE, all of the former works are about co-axial cylinder tube. However, this model may cause engine cooling difficulties in real engine design. Contrast to a co-axial tube, a cylinder tube without inner wall may greatly reduce the difficulties in engine cooling.

Here, a rotating detonation wave propagating in a cylinder tube is three-dimensionally simulated with one-step chemical reaction model. The governing equation is Euler equation on general coordinate. Overset grid approach is used to avoid the difficult in computing singular points on the tube center line. A rotating detonation wave (DW) is generated through direct ignition of injected combustible gas by one-dimensional ZND detonation wave (DW). After several milliseconds, the flow field converges to two rotating detonation waves propagating with center symmetry. Also, propelling performance of a series of engine sizes is discussed here.

Rotating Detonation Waves can continuously propagate in hollow cylinder tube. The heat load in co-axial tube is avoid in the hollow tube. CDEs represent an essentially innovative combustor design for a future propulsion system. They are easy to substitute as combustors for conventional aviation systems to achieve mainly higher performances. Moreover, the simple CDE design offers economic and low-risk benefits when combined with existing engines. Once proven to be effective, CDEs are expected to be immediately available as upgrades for jet engines or rocket motors.