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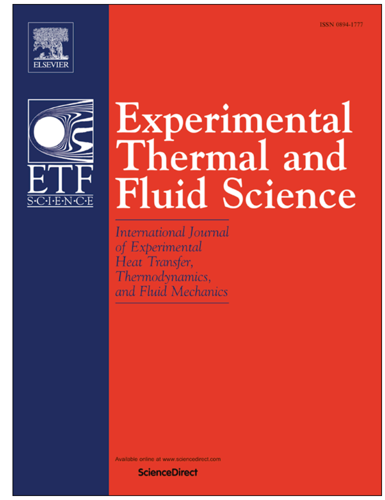

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M.L. Fotia, J. Hoke, F. Schauer

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Study of the Ignition Process in a Laboratory Scale Rotating Detonation Engine

M.L. Fotia[a,*], J. Hoke[a], F. Schauer[b]

[a] *Innovative Scientific Solutions Inc., Dayton, Ohio, U.S.A. 45459*
[b] *U.S. Air Force Research Laboratory, WPAFB, Ohio, U.S.A. 45433*

Abstract

A rotating detonation engine is tested in a direct connect configuration to identify the impact of different geometric and flow parameters on the ignition processes within these devices. Identification of the relationship between the predetonation chamber pressure and the rate of pressure rise within the fuel and air feed manifolds is a feature of this work. Steady detonating Operation on gaseous hydrocarbon fuel is presented to identify the pertinent scaling laws that govern the transition of rotating detonation engine based combustion systems to steady detonating operation. Instances of acoustic operation and partial, or suppressed, detonating ignition are examined to further understand the various aspects of the propellant feed systems that influence the ignition process.

1. Introduction

The rotating detonation engine implements a pressure-gain combustion cycle in a viable, compact device. The ignition of such devices and the subsequent transition to steady detonating operation is a key component of the successful development of this technology. The examination of the behavior of back-pressured rotating detonation engine combustion chambers and the identification of the driving physical processes affecting ignition is the focus of this work. In a practical sense, the successful initiation of a rotating detonation engine is required to enable the study of the steady state operation of such devices under a wide range of propellant supply conditions.

Operation of rotating detonation engines of different nominal detonation channel diameters and configurations has been reported by Naples et al.[1], Fotia et al.[2?], Frolov et al. [3] and Dyer et al.[4]. Naples et al. examined a six-inch nominal diameter device through the use of a quartz outer-body and high-speed

*Corresponding author
Email addresses: matt.fotia@gmail.com, matthew.fotia.ctr.ca@us.af.mil (M.L. Fotia), john.hoke.4.ctr@us.af.mil (J. Hoke), frederick.schauer@us.af.mil (F. Schauer)