Rotary Pressure Gain Combustor for Gas Turbine Performance Enhancement

The proposed ignition method is investigated in the IUPUI Combustion & Propulsion Laboratory using a single-channel internal combustion wave rotor owned by NASA. In this innovative design, channel mixture is ignited by a transient hot jet from a spinning pre-chamber.

The pressure gain combustor is a device designed to produce an increase in total pressure during combustion, and necessarily employs unsteady, intermittent combustion. The interest in using pressure gain combustors is because they approach the constant-volume combustion of the ideal Humphrey cycle, which has a fundamental thermodynamic advantage over the Brayton Cycle created by conventional constant-pressure combustors.

Jet injection of already-burned gas from a neighboring channel or pre-chamber is called "combustion-torch ignition." Stronger and faster than electric spark ignition, it makes the combustion process essentially continuous, without need for pulsed methods with ignition delays.

Sample Pressure Data

Pressure traces recorded from experimentation.

Present Work

- Determining exhaust gas temperature of supersonic nozzle
- Determine ignition characteristics of hydrogen
- Measure flame front velocity
- Capture ignition initiation with a time scale of 1 millisecond

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The computational fluid dynamics code StarCD is used to predict internal flow and combustion upon attempted ignition by a hot gas jet. The plots show fuel mass fraction (left) and density (right) as functions of time after opening the channel inlet to the incoming hot gas jet.