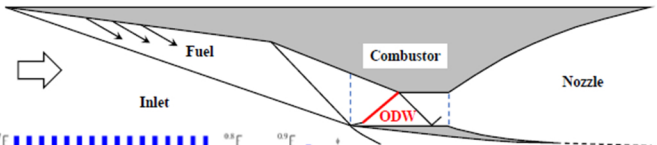
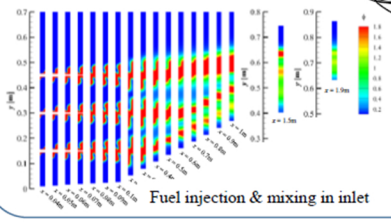
Aerospace Propulsion and Combustion

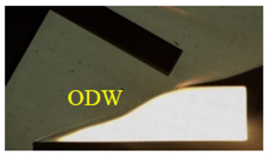
Study I: Oblique Detonation Propulsion

- Key techniques: mixing, preignition, initiation and stabilization
- Reveal various flow destabilized mechanisms in combustor
- Demonstrate this propulsion concept through wind-tunnel tests





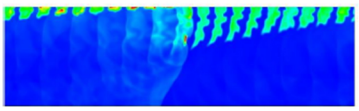
Fuel injection & mixing in inlet



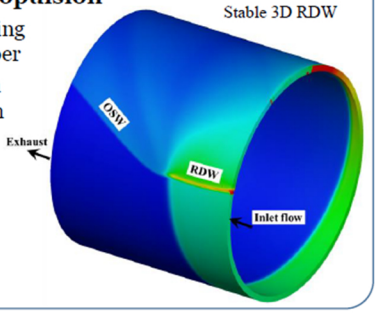
Stabilized ODW in combustor

Study II: Rotating Detonation Propulsion

- Formation of continuously propagating detonation in the combustion chamber
- Stable operation was achieved with a wide range of inflow velocity for both hydrogen and hydrocarbon fuels

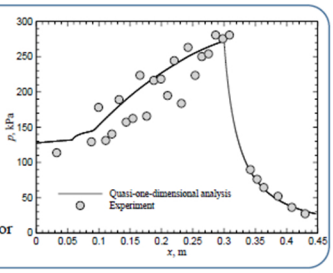


Corrugated wave front with non-uniform injections



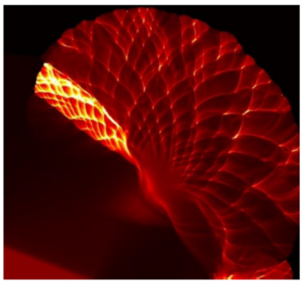
Study III: Scramjet Propulsion

- We developed a quasi-one-dimensional analysis to characterize the combustion mode
- The effect of equivalence ratio on the combustion mode transition was identified

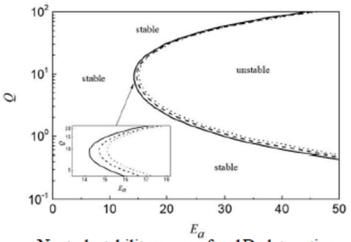


Surface pressure in combustor under fuel-lean condition

Study IV: Dynamics of Detonation



Evolvement of a planar detonation into a cylindrical detonation



Neutral stability curve for 1D detonation with vibrational non-equilibrium

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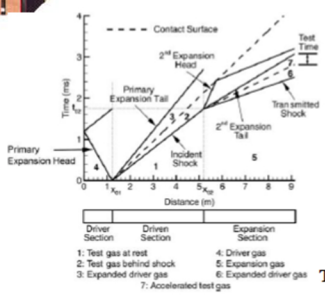
Research Interest I: Hypersonic wind tunnels

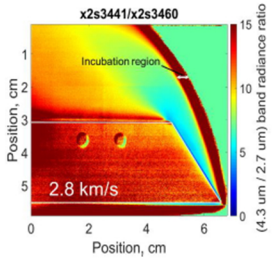
- Development of improved methods to characterize hypervelocity wind tunnel test conditions
- Publication of a review paper on these facilities



The expansion tube

Research Interest II: Thermochemical nonequilibrium

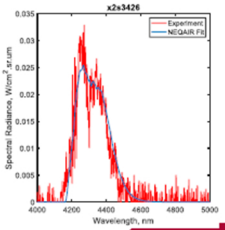
- Conducted one of the first studies of CO_2 thermochemical nonequilibrium and radiation under expanding flow conditions in an expansion tunnel.
- Identified new thermochemical characteristics of CO_2 expanding flows which is applicable for understanding the afterbody flow around planetary entry vehicles.



Filtered imaging of a hypersonic CO_2 flow

Research Interest III: Spectroscopy

- Assembled one of the first mid-infrared emission spectroscopy system for an expansion tunnel and, correspondingly, created a new calibration procedure.
- Cross-validation was achieved with corresponding filtered imaging results.



Emission spectroscopy of CO_2