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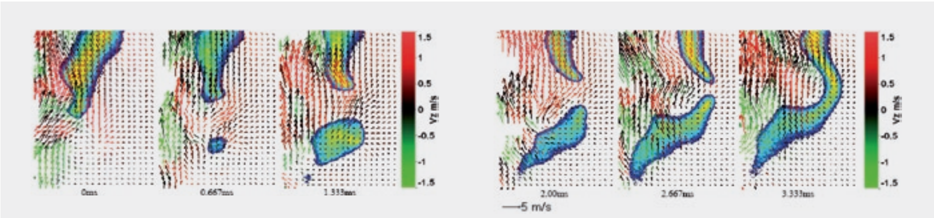
Experimental Investigation of Ignition and Auto-ignition



OH-PLIF / 3 Component PIV sequence highlighting the formation and merging of a flame island in a lifted jet flame.

Motivation

In many combustion applications, such as during the relight of an aviation gas turbine (GT) during flight, the phenomenon of ignition from a localised spark is important. Understanding the mechanisms involved can provide tools to alter the design of GT burners and combustion chambers for improved flight safety and fuel efficiency. Auto-ignition is also a phenomenon of great practical interest to combustion engineers in the design of diesel engines, HCCI engines, supersonic combustion ramjets, and gas turbines. Both phenomena involve transient, finite-rate combustion processes, and are significantly affected by turbulence-chemistry interactions. As a result of this, accurate prediction of these phenomena remains a significant challenge. Specialised experiments need to be conducted to develop fundamental understanding of the physics and chemistry of these processes. This understanding can then be used to develop more accurate models for the simulation and design of industrial burners.

Methods

The laser diagnostic techniques that will be applied to develop understanding of these phenomena include planar laser induced fluorescence (PLIF) of mixture fraction and combustion radicals, Rayleigh scattering imaging for determining temperature, and particle image velocitmetry (PIV) to determine flow field information (see images below for examples). High repetition rate experiments (kHz) are required to resolve the small time scales, all 3 components of velocity will be measured, and simultaneous data from more than one plane may also be required. The techniques will be developed on well-characterised simple burners, and then applied to progressively more complex burners such as the TECFLAM burner.