THE UNIVERSITY OF MELBOURNE

Mechanical Engineering

SEMINAR SERIES 2008

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Charles Pearson Theatre, Level 1, Education Resource Centre, Bldg 171

Direct numerical simulations of turbulent combustion: Fundamental insights towards predictive models.

The advancement of our basic understanding of turbulent combustion processes and the development of physics-based predictive tools for the design and optimization of the next generation of combustion devices are strategic areas of research for the development of a secure, environmentally sound energy infrastructure.

Direct numerical simulation (DNS) is a high-fidelity modelling approach that completely resolves all continuum scales of a reacting flow problem, and is used increasingly as a valuable tool for scientific discovery and model development in combustion. Large allocations of supercomputing time through the US Department of Energy have provided unique opportunities to use DNS to tackle new problems.

In the seminar I will discuss two applications of DNS. First, I will discuss the use of DNS to model combustion processes typical of Homogeneous Charge Compression Ignition (HCCI) engines. HCCI is a promising route towards realizing low emissions and high efficiencies, but prior to the study, little was known about the structure of combustion waves in HCCI. DNS is used to characterize these waves, and then used to develop engineering models that can facilitate the engine-design process.

Second, I will discuss the use of some massively parallel DNS of turbulent nonpremixed plane jet flames to examine the consequences for the experimental estimation of a parameter that is a key determinant of flame stability - the scalar dissipation rate. The scalar dissipation rate is a quantity involving three-dimensional gradients but measurements are typically based on one and two-dimensional gradient measurements. The DNS are used to show how the statistics of the lower dimensional measurements can be related to the true 3D value statistics.

Dr Hawkes' research centres on alternative fuel and low-emissions combustion technologies. He develops and applies high-fidelity computational models to understand and predict the behaviour of the multi-scale, multi-physics flows that govern the performance of these technologies. Dr Hawkes earned BSc and BEng degrees from the University of Western Australia, and a PhD from the University of Cambridge. He worked as a postdoc at the Combustion Research Facility at Sandia National Laboratories and is now a Senior Lecturer at the University of New South Wales.

MORE INFORMATION

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