[Subject category: Combustion]

A BURNING QUESTION

Combustion is central to our society. It is estimated that some 90 per cent of the world's entire energy requirements, from electricity to transport, are met ultimately from the burning of fuel.

The big challenges in combustion technology include improving the performance of engines such as gas turbines that are used in power stations and jet aircraft and reducing the amount of harmful exhaust emissions.

Sophisticated three-dimensional computer models of combustion are key to making these improvements. "In a combustion system fuel typically burns in a stream of turbulent air," says Dr Stewart Cant of the University of Cambridge. "We need to know how the flame is behaving in very fine detail. Experiments alone cannot provide the kind of information we need about the three-dimensional behaviour of the system or how it changes over time. Only computer modelling can provide these answers."

To model the complex interactions between the air and the flame, the combustion space is divided into a grid of millions of three-dimensional elements. As the combustion proceeds, the computer calculates what is happening at each point. "Typically one could have 50 to 100 million points in a simulation," says Dr Cant. "You must simultaneously calculate what is happening at each point and then advance the simulation in time at whatever rate is necessary. To resolve this very rapid phenomenon that is occurring at sub-millimetre scales over a very large area is computationally demanding."

The results of these simulations are passed to industry, which uses the data to improve and refine its own models, ultimately resulting in new designs for improved combustion systems.

"HECToR will allow us to do many runs of these kinds of simulations," says Dr Cant. "And if we can get a simulation of 200 million points I will be very happy."

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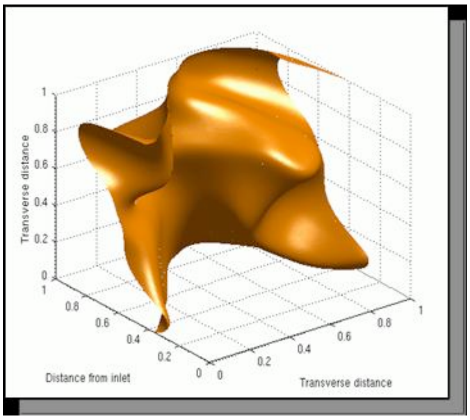

Old flame…numerical simulation of a flame propagating in a mixture of fuel and air