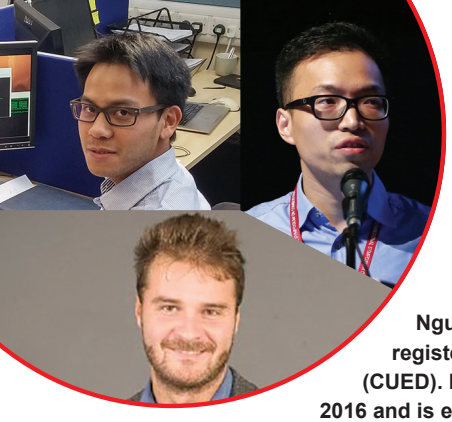
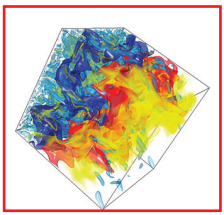
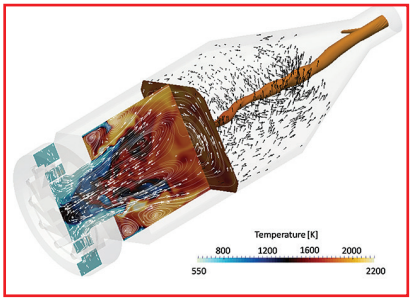


Nguyen Anh Khoa Doan, Zhi Chen & Ivan Langella

University of Cambridge

Nguyen Anh Khoa Doan is currently a PhD Student registered at Cambridge University Engineering Department (CUED). Dr Zhi Chen obtained his PhD from CUED in October 2016 and is employed as a postdoctoral research associate at CUED. Dr Ivan Langella obtained his PhD from CUED in January 2016 and is also currently employed as a post-doctoral research associate. They plan to use their prize to visit the Combustion Research Facility (CRF) at the Sandia National Laboratory, Livermore, California, USA.





Our research project aims to improve the efficiency of engines to reduce pollution. Worldwide, energy demand is increasing, and most energy is produced by combustion. It is thus very important to improve combustion engines so they are more efficient. If an engine is more efficient, not only will it produce more energy with the same amount of fuel, it will also be less polluting.

We use Computational Fluid Dynamics (CFD), to model how fluids move through engines. Our research group creates accurate models of engines using Direct Numerical Simulation. We then use Large Eddy Simulation (a type of simulation focused on turbulent flows) to study flames. An excellent understanding of the complex properties of flames is needed to develop “green” engines.

These insights are translated to simple mathematical models, which are implemented in a LES code, OpenFoam. Our simulations require a large number of cores, typically many thousands, and wall clock-times of 24 to 550 hours. These requirements can only be met using ARCHER.

Turbulent combustion is a socio-economically important topic with multi-scale and multi-physics. This means there are considerable challenges in studying this topic. The scales involved pose many computational and modelling challenges. These attributes mean that using ARCHER was a natural fit. To reach the level of detail required to build robust engineering models, using ARCHER was the only feasible solution. A careful evaluation and validation of models for combustors with complex geometry and flow also needs ARCHER. These validated engineering models can then be used by the end user – industries such as oil and gas, automotive, etc.

In order for combustion engines to find their place within a changing energy market, they need to improve dramatically. Burning fuel remains one of the simplest ways to produce energy, but it is no longer environmentally acceptable in its current form. Using ARCHER, we hope to contribute to making combustion engines more efficient and less polluting.