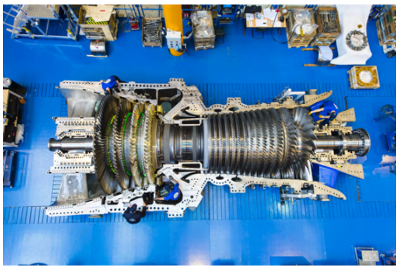
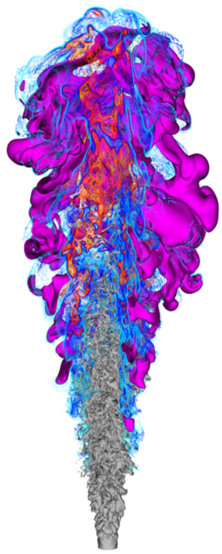
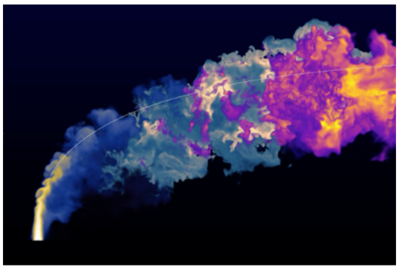
PhD scholarships in renewable fuel combustion

Enable a net zero emissions future by accelerating the development of large-scale, efficient, and reliable combustion technologies for utilising renewable fuels in power generation, heavy-duty ground and ship transportation, and aviation.



Background

As the world transitions to a net zero carbon future, primary energy production is expected to be provided mostly by renewable sources such as solar and wind. However, renewable energy generation is frequently not matched to utilisation, either geographically (the utilisation is far from generation) or temporally (the utilisation happens at a different time to generation). Hence, energy storage of some form is required. In addition, applications such as heavy-duty transportation and aviation require energy sources that have high energy densities for their efficient operation. Storing renewable energy in a chemical form, *i.e.* as a fuel, offers the prospect to solve storage problems, if a reliable, efficient and robust means of conversion of the fuel energy into mechanical or electrical energy can be developed. Renewable fuels of interest include hydrogen, ammonia, and others.

For large-scale power generation and transportation, large piston engines and gas-turbines offer the strong advantages of high efficiencies, extremely high power densities, low cost, and reliable, robust operation. However, these engines have been designed to burn conventional fuels such as diesel, jet fuel, and natural gas. The combustion characteristics of hydrogen and ammonia, and other renewable fuels, differ significantly from those of conventional fuels, which implies combustion strategies need to be redesigned. Also, this needs to happen very quickly, within a decade or two at the most, which is a much shorter development timeline than current engines were developed within.

Engineers in industry are currently hampered in their development efforts because so little is known about the combustion of renewable fuels, and engineering models of combustion that can be used in design of the combustion strategies are lacking.

You can be a part of the massive change that needs to happen by providing the knowledge that is missing. Working in part of the research group of Professor Evatt Hawkes, together with a team of PhD students and postdocs, you will use some of the world's largest supercomputers to carry out very detailed computational fluid dynamics simulations of combustion of renewable fuels. These simulations will provide the missing information and hence empower industry to rapidly develop and deploy engines capable of exploiting renewable fuels.

Available Projects

The applications we are currently most interested in are:
- Hydrogen and/or ammonia combustion in heavy duty compression ignition engines, used in trucks, ships, and power generation.
- Hydrogen and/or ammonia combustion in gas turbines, used in power generation and aviation.

We can tailor the projects to the student's interest but generally we can offer:
- Purely fundamental projects that establish the nature of renewable fuel combustion in engines by using large scale computations.
- Practically applicable projects which use large-scale computations to develop practically applicable models of combustion, which don't require a supercomputer to run, that engineers can directly use in the design process.
- In some areas, more directly practical projects which use engineering combustion models to help in the process of early-stage technology development.

Some of these projects will involve collaboration with industry partners including GE (gas turbines), MAN Energy Solutions (compression ignition engines). Additionally, we anticipate that students will be able to spend some time with our strong research collaborators at national laboratories in California and Norway. Finally, for those interested in experimental work, joint experimental and numerical projects are available with primary or joint supervision with Professor Shawn Kook or Dr. Shaun Chan.

The scholarship value is expected to be ~$39k per annum ($29k base RTP rate plus $10k top-up from the Faulty and School). On particular topics, outstanding candidates may be offered an additional $5k per annum in 2022 and 2023.

Contacts

Interested applicants are welcome to discuss potential projects with Evatt, who you can recognise from the picture to the right, or via contacting Evatt by email at:

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