High-speed fluid mechanics research at the University of Queensland

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Abstract

The Centre for Hypersonics (CfH) at the University of Queensland (UQ) was established in 1997 and built on Ray Stalker's pioneering work in hypersonics at UQ starting in 1980. It is recognized as one of the largest and the leading university-based hypersonics research group in the world. With more than 170 higher degree research graduates since its inception and several world-firsts achievements, the Centre has a legacy of producing high quality research over a range of topics in high-speed flows. These include hypersonic air-breathing propulsion, high-speed aerothermodynamics, ground-testing facilities development, computational fluid dynamics (CFD) and flight testing.

The Centre boasts several world-class free piston-driven test facilities, allowing investigation of a range of aerodynamic/supersonic combustion phenomena suitable for atmospheric hypersonic flight and planetary entry. These facilities are divided into shock tunnels and expansion tubes, and are known for producing reputable datasets. Two reflected shock tunnels, T4 and X3/R are capable of producing flows of test section Mach numbers from 4 to 10 at enthalpies up to 20 MJ/kg, and are typically used for studies on boundary layer transition, scramjet combustion and aerothermodynamics. Two super-orbital expansion tubes, X2 and X3, are capable of providing test-flows for both planetary entry studies up to Jupiter entry conditions and atmospheric boost-glide type of studies. Diagnostics in these facilities range from laser- and non-laser-based optics, force and pressure sensors, to heat transfer gauges.

Besides experimental approach, another of CfH's strength is multi-fidelity computational modelling. Using our expertise and experience, together with our suite of numerical tools, we are able to perform system level engine/vehicle/facility simulations, steady laminar, RANS and LES simulations, as well as DNS and multi-fluid plasma simulations.

Keywords: hypersonics, shock tunnel, CFD, scramjet, radiation

Figure 1. Overview of capabilities at Centre for Hypersonics at the University of Queensland.

Acknowledgments

We sincerely thank the Asian Fluid Mechanics Committee (AFMC) for their exceptional efforts in organizing the 18th Asian Congress of Fluid Mechanics (ACFM) scheduled to be held in Seoul, Korea, from September 10 to 13, 2025.