MONASH
ENGINEERING

MONASH University

Faculty of Engineering

Summer Research Program 2022-2023

Project Title: **Direct numerical simulation (DNS) using immersed boundary method of surfaces bio-mimicking shark skin to reduce drag**

Supervisor(s): **Professor Julio Soria**

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Objective

The objective of this summer research project is to: (1) develop the formulation of embedded body forces to implement in our high-performance parallel direct numerical simulation (DNS) code, (2) implement, testa and verify it in the DNS code, (3) use the code to investigate the turbulent flow over functional customised aerodynamic surfaces such as bio-inspired shark skin riblets to reduce drag.

Project Details

Wall-bounded turbulence is responsible for skin friction drag on aircraft, ships, trains, trucks and cars. For example, it is noteworthy that skin friction drag contributes to 60-70% of the total drag for a cargo ship, 80% for a tanker and 90% for underwater vehicles and that shipping alone accounts in usage for 8.5% of the global oil supply and 3.3% of the world's CO_2 emissions.

This project will use advanced parallel direct numerical simulation codes with embedded body forces to investigate the turbulent flow over a class of new functional customised aerodynamic surfaces such as superhydrophobic surfaces and bio-inspired shark skin riblets which have shown promising drag reduction.

This research is fundamental to the development of novel technologies that reduce and control drag in all transport platforms and therefore, reduce fuel consumption and CO_2 emissions in the transport industry. The basis for this research is our in-house high performance direct numerical simulation code writhe in F90 using hybrid MP and MPI parallelisation. This project will develop the formulation, implementation and testing of embedded body forces that will allow the high-fidelity simulation of the turbulent flow over functional customised aerodynamic surfaces such as bio-inspired shark skin riblets to reduce drag.

Prerequisites

Third-year Mechanical or Aerospace Engineering student **who will continue this project into a FYP in 2023**.. HD in either MAE 3401 or MEC 3451 (essential), HD/D average in Mathematics (preferable).

Additional Information

If shortlisted you will be required to attend an interview.