OIST OKINAWA INSTITUTE OF SCIENCE AND TECHNOLOGY GRADUATE UNIVERSITY

Shocks, Solitons and Turbulence Unit (Emile Touber)

FY2020 Annual Report

Shocks, Solitons and Turbulence Unit
Associate Professor Emile Touber

Unit "Zoom" meeting in October 2020.

Abstract

The Shocks, Solitons and Turbulence (S2T) Unit carries theoretical and computational studies of energy transfers and transport arising from shock/solitary waves and turbulence. We work on a variety of problems (from cosmic to biological scales) expressed in terms of (i) fields obeying some form of conservation laws, (ii) closed using physics-based or simple behavioral arguments, (iii) and found in a turbulent and/or shocked regime. Our current activities are articulated around three main themes: complex fluids, active fluids, analogous fluids.

The S2T Unit main activities this year have been to build a team under Covid times; develop a computational framework to solve systems of hyperbolic partial differential equations efficiently on both x86 (Intel, AMD) and ARM machines (e.g. Fugaku) and apply it to simulations of compressible turbulence near the liquid-vapor critical point. Whilst the Unit is theoretical and computational in nature, significant efforts were invested in the planning and development of field experiments to support activities related to car traffic flows and marine science. More details on this in next-year report.

1. Staff

- Emile Touber, Associate Professor
- Stephen Winn, PhD student visiting from Imperial College London
- Alicia Murga, Postdoctoral researcher
- Himani Garg, Postdoctoral researcher
- David Lusher, Postdoctoral researcher

- Yussuf Ali, Technician
- Andre Krichikov, Technician
- Saori Chappell, Research Unit Administrator

2. Collaborations

Computational framework to solve systems of hyperbolic PDEs

- Description: We collaborate with Prof. Nicolas Alferez on the development of a computational framework to solve systems of hyperbolic partial differential equations. As part of this collaboration, we were given early access to Japan's new supercomputer (Fugaku) to test our framework on the compressible Navier-Stokes equations.
- Type of collaboration: Joint research
- Researchers:
    - Professor Nicolas Alferez, Arts et Métiers ParisTech (France)

3. Activities and Findings

As the unit is just starting, please refer to future reports for details about current activities and early findings.

4. Publications

4.1 Journals

Nothing to report.

4.2 Books and other one-time publications

1. Winn S.D., Touber E. (2021) Non-ideal Gas Effects on Supersonic-Nozzle Transfer Functions. In: Pini M., De Servi C., Spinelli A., di Mare F., Guardone A. (eds) Proceedings of the 3rd International Seminar on Non-Ideal Compressible Fluid Dynamics for Propulsion and Power. NICFD 2020. ERCOFTAC Series, vol 28. Springer, Cham.

4.3 Oral Presentations

1. Winn, S.D. *Non-ideal gas effects on supersonic-nozzle transfer functions*, NICFD2020, Deft, Netherlands, 2020.10.29

5. Intellectual Property Rights and Other Specific Achievements

Nothing to report.

6. Meetings and Events

Nothing to report.

7. Other

Nothing to report.