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2020 Newsletter — Scientific Computing and Flow Physics Laboratory

SCFPL this Year

PhD Students: Eunhye An, Erin Burrell, Griffin Cearley, Sonya Dick, Codie Fiedler-Kawaguchi, Minki Kim, Nick Lucido, Kevin Ma, Lauren Mancina, Kazuya Murakami, Samuel Pellone, Suyash Tandon, Michael Wadas

MS Students: Sahil Bhola, Maryknoll Dsouza, Suzie Shoffner, Mizuho Takayama, Sijian Tan

UG Students: Joseph Delaney, Ricardo de Jesus Duran Trevino, Eric Hersey, Anish Rao, Yuenong Ling, Rohan Wagle, William White

Post-docs: Shahab Beig, Loc Khieu, Chiwon Kim

Admin: Diane Brouwer, Karen Brown

PI: Eric Johnsen

Research Highlights

- *Multiphase flows.* Using theory and high-fidelity simulations, we seek to understand energy transfer during bubble growth and collapse to better understand the lifetime of a bubble. Additionally, by combining numerical modeling and experiments, we measured, for the first time, the nuclei size distribution in water.
- *High-energy-density physics.* We are using theory and simulations to investigate shock strengthening in laser compression experiments, vorticity dynamics of shock-accelerated interfaces, and the ejection of vortex dipoles. We are also studying mechanical impulse produced by x-ray-illuminated materials and thermal transport in laser-irradiated materials.
- *Turbulence.* We are investigating mixing at turbulent/less-turbulent interfaces, as well as modulation of separated regions using vortex generators.
- *Scientific Computing.* We are developing Discontinuous Galerkin methods for high-fidelity simulations of the compressible Navier-Stokes equations on arbitrary meshes. We are also exploring mixed-precision strategies and fault recovery in the context of exascale computing.

This past year, articles with contributions from our group appeared in J Comput Phys, Phys Med Biol, Phys D, Ultras Sonochem, J Mech Phys Solids, Ultrasound Med Biol. The group had good representation at the APS-DPP and APS-DFD meetings, and also presented at AVIATION, SNH, SC20, ASCO, and laser user group meetings (NIF/JLF).

We also started new projects on droplet dynamics and x-rays interacting with materials under hypersonic-relevant conditions, supported by LLNL and NNSA.

We take this opportunity to acknowledge the invaluable contributions from our research collaborators this past year: C. Franck (Wisconsin), D. Henann (Brown), T. Colonius (Caltech), K. Ando (Keio U.), E. Vlaisavljevich (Virginia Tech), H. Hoffmann (U. Chicago), C. Barbier (ORNL), M. Patel, M. Millot, L. Berzak-Hopkins, P. Porazik (LLNL), C. Di Stefano, A. Rasmus (LANL), S. Ceccio, J. B. Fowlkes, C. Kuranz, K. Maki, J. Sukovich, Z. Xu (U-M), as well as former group members M. Rodriguez (Caltech), R. Gaudron (Imperial College) and S. Shinde (Aptiv). We are also grateful to our sponsors for their support: ONR, DOE, NSF, NIH, LLNL, LANL, ORNL, BSC, and MICDE, as well as ALCF, OLCF, and XSEDE for computing resources.

Group Happenings

This year was of course was challenging for everyone due to the COVID-19 pandemic, and hopefully you are in good health. Our group switched to remote work from March onward, with no work-related travel. We still have no timeline as to when we will be able to return to an in-person setting. While the situation has brought about a number of difficulties, it has been heartwarming to see everyone pull together and help each other out. We enjoyed socially distant gatherings and virtual game nights. Naturally, a staple of remote work has been Zoom/Bluejeans meetings. Additionally, we started the tradition of Friday Social Hours, which we hope to continue beyond the pandemic.



This year, we were excited to welcome new group members:

- PhD students Erin Burrell and Codie Fiedler-Kawaguchi (since Fall 2020)
- Undergraduate student Yuenong Ling (since Spring 2020)
- MSTP rotator Suzie Shoffner (Spring 2020)
- Post-doctoral scholar Loc Khieu (since January 2020)

We also celebrated a record four PhD thesis defenses this past year:

- Lauren Mancina, April 2020
- Suyash Tandon, May 2020 (with Marc Henry de Frahan serving as a committee member)
- Kazuya Murakami, November 2020
- Samuel Pellone, December 2020

Angela Tija Sin Wu (who was primarily advised by Volker Sick) also defended this year.

It was a complicated year for internships and other similar experiences. Nevertheless, Griffin was able to do a remote summer internship with LLNL working on mechanical impulse generated by x-rays interacting with matter.

Congratulations!

The group had a prolific year in terms of awards, congratulations to:

- Erin Burrell, 2020 NSF Graduate Research Fellowship
- Michael Wadas, 2020 Poster Award at NIF User Group Meeting
- Minki Kim, 2020 Alumni Association Scholarship (Seoul National University) and 2020 Phi Kappa Phi Chapter 39 Project Grant Scholarship Award (U-M)
- Codie Fiedler-Kawaguchi, 2020 MIPSE Graduate Fellowship
- Rohan Wagle, 2020 UROP Blue Ribbon Award
- Eric Hersey, Fall 2020 best poster presentation at the MEUS
- William White, Winter 2020 best paper award at the MEUS

It's hard to keep track of all these achievements, please let me know if I've missed any...

Alumni News

On a more positive note, zoom meetings and thesis defenses were good opportunities to connect with group alumni. We held our first virtual APS-DFD group reunion—it was great to see everyone! It was also nice to “see” alumni at thesis defenses and other events. Hopefully we can continue to provide online access to enable these connections.



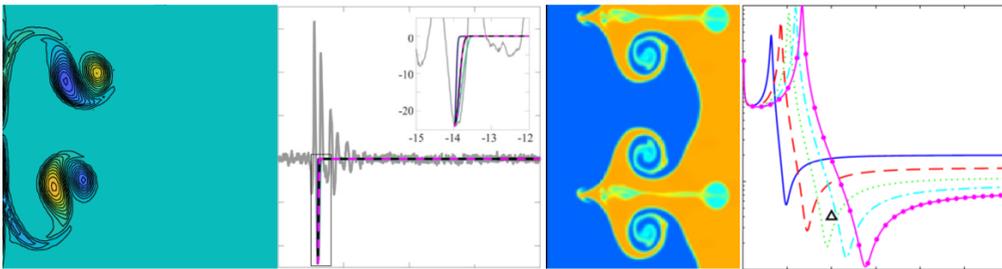
In other notable news:

- Aditya Nair started as Assistant Professor in Aerospace Engineering at University of Nevada, Reno.
- Marc Henry de Frahan was part of a team who received a Gallery of Fluid Motion award at the APS DFD meeting—congratulations!
- Brandon Patterson started as Senior Engineer and Developer at the Applied Physics Laboratory (JHU).
- Matthew Warnez started a PhD at Oxford.
- Sriram Sivakumar an MSc at University College London.
- Shaowu Pan defended his PhD (U-M Aero)—congratulations! He will be starting a postdoc at U. Washington with Nathan Kutz.
- Shahab Beig started as staff associate at Continuum Dynamics, Inc.
- Suyash Tandon started as an MTS System Software Design Engineer at AMD.
- Kazuya Murakami started as an engineer at Bosch Japan.

To all SCFPL alumni and friends: please stay in touch!

Other Newsworthy Items

Unfortunately, we had to cancel our group symposium due to the pandemic, but we hope that we will get a chance to hold one in the near future.



Selected artwork from this year’s papers (Philip Johnson, Lauren Mancina, Michael Wadas, Kazuya Murakami).

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