IOWA STATE UNIVERSITY

Center for Multiphase Flow Research and Education

CoMFRE June 2019 Newsletter - corrected version

This is an updated version of our June 2019 CoMFRE Newsletter. Some content in the "CoMFRE and CoMFRE Affiliates in the News" was lost in the version that you received earlier today. Below is the complete summary of our activities and accomplishments over the past three months. Please contact us if you would like more information on any item listed below.

Message from the Director

The summer is off to a great start. For a faculty member, it is filled with writing and editing reports, papers, and proposals. I completed three project reports last week alone. As July 1 is right around the corner, the summer for ISU faculty will be half over with the fall semester starting August 26.

CoMFRE is using the summer time to reorganize and update our web site and that should be completed by the September newsletter. We are also planning a fall meeting for **October 28-29, 2019, in Ames**. More details are provided below.

Enjoy the rest of the summer. As you participate in typical summer activities from time at the pool or on the lake to enjoying a hamburger and your libation of choice, remember they all involve multiphase flows in one form or another.

With kind regards,

Theodore (Ted) J. Heindel
Director, Center for Multiphase Flow Research and Education
Bergles Professor of Thermal Sciences

CoMFRE Symposium & IAB Meeting, October 28-29, 2019

Mark your calendars for the 2019 CoMFRE Symposium and Member Meeting, October 28-29! Industry members will receive updates on shared research and meet with CoMFRE faculty and students to discuss future research and goals for the center. In addition to presentations and a poster session, there will be ample opportunities for networking and interaction among industry representatives, faculty, graduate students and postdocs.

- October 28, 3-5 pm: closed meeting, CoMFRE members only.
- October 28, 6-9 pm: open meeting; student poster session and reception at 6 pm, dinner at 7 pm.
- October 29, 8 am - 3 pm: open meeting; posters on display throughout.

Feel free to contact Jan Seibel (jseibel@iastate.edu) if you would like more information on our annual meeting. A draft Agenda and registration information will be posted on our website soon.

CoMFRE and CoMFRE Affiliates in the News

- **In a heartbeat: Machine learning speeds up heart-valve simulations:** A trio of assistant professors in mechanical engineering at Iowa State University combined their research interests into a larger project under the umbrella of Iowa State's Center for Multiphase Flow Research and Education (CoMFRE). **Adarsh Krishnamurthy**, **Ming-Chen Hsu**, and **Soumik Sakar** are using machine learning to simulate heart valve

movement and the mechanics of the fluid moving through the heart chambers, and they are able to do this in a matter of minutes as opposed to a matter of years. https://news.engineering.iastate.edu/2019/05/29/in-a-heartbeat-machine-learning-speeds-up-heart-valve-simulations/

- **Big research experience building a small device: Mentoring duo creates first-of-its-kind portable viscosity instrument:** McNair mentor and assistant professor in mechanical engineering at Iowa State University, **Jaime Juarez**, has been working with Antonio Alvarez Valdivia, McNair Scholar and junior in mechanical engineering, to create a portable system for measuring fluid viscosity that otherwise would require a lab-scale instrument. With the help of Soheila Shabaniverki, graduate assistant in mechanical engineering, the mentoring duo has been testing the accuracy of this portable optical microscope to determine if the results are comparable to the research grade microscope.

https://news.engineering.iastate.edu/2019/05/20/big-research-experience-building-a-small-device-mentoring-duo-creates-first-of-its-kind-portable-viscosity-instrument/

- **Predicting fuel drop-wall interactions, optimizing engine performance: Song-Charng Kong**, professor of mechanical engineering, and **James Michael**, assistant professor of mechanical engineering, are working with the Army Research Laboratory to develop computational models that predict the phenomena of fuel dropping onto the engine piston surface. These predictions will be useful to the U.S.

military because they can be used to design more effective engines, particularly when using nontraditional fuels, such as those of interest for the military. https://news.engineering.iastate.edu/2019/06/07/predicting-fuel-drop-wall-interactions-optimizing-engine-performance/

- **Tim Morgan receives post-doc seed grant:** Tim Morgan, a post-doc in the Experimental Multiphase Flow Laboratory, has received a 2019 Postdoctoral Scholar Seed Grant Award for a project entitled "Development of a Small-Scale Magnetic Resonance Imaging System for Multiphase Flow Characterization." https://news.engineering.iastate.edu/2019/05/14/three-engineering-postdocs-win-research-and-seed-funding-awards/
- **Chris Rehmann**, associate professor of civil, construction & environmental engineering, has received the ISU Alumni Association Faculty/Staff Inspiration Award: https://news.engineering.iastate.edu/2019/05/14/trusted-advisor-strong-example-rehmann-wins-isuaa-faculty-staff-inspiration-award/
- **Soumik Sarkar**, assistant professor of mechanical engineering, was recognized by the ISU college of Engineering for Early Achievement in Research: https://news.engineering.iastate.edu/2019/06/07/excellence-of-purpose-faculty-and-staff-recognized-with-college-of-engineering-awards/
- **Ming-Chen Hsu**, assistant professor of mechanical engineering, will receive the prestigious 2019 U.S. Association for Computational Mechanics Gallagher Young Investigator Award: https://news.engineering.iastate.edu/2019/04/25/ming-chen-hsu-receives-gallagher-young-investigator-award/

Upcoming Promotions Announced for CoMFRE Faculty

- **Ming-Chen Hsu**, Mechanical Engineering, from Assistant Professor to Associate Professor with Tenure
- **Soumik Sarkar**, Mechanical Engineering, from Assistant Professor to Associate Professor with Tenure

- **Travis Sippel**, Mechanical Engineering, from Assistant Professor to Associate Professor with Tenure
- **Theodore J. Heindel**, Mechanical Engineering, from Professor to University Professor

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Recent Degrees Granted to Students Working on Multiphase Projects

- Meghana Akella, PhD, “Acoustofluidic Self-Assembly of Colloidal Materials for Additive Manufacturing." Advisor: **Jaime Juarez**
- Liyun Feng, PhD, “Combustion of Aluminum/Boron/PTFE Ternary Nanoscale Thermites.” Advisor: **Travis Sippel**
- Yaoyu Pan, PhD, “Particle scale simulation method for multiphase flow study.” Advisor: **Song-Charng Kong**
- Patrick Sanderson, MS, “Thermal decomposition and inactivation of chemical warfare simulants.” Advisor: **Travis Sippel**

New CoMFRE Faculty Affiliates

The following faculty have joined CoMFRE as faculty affiliates. A full list of CoMFRE faculty affiliates can be found here: https://comfre.iastate.edu/team-2/.

- **Song-Charng Kong**, professor of mechanical engineering. Song-Charng has been at Iowa State since fall 2005 and recently returned after spending three years as a program manager at the National Science Foundation. He has research interests in the areas of spray combustion, alternative fuels, emissions, gasification, and CFD. https://www.me.iastate.edu/faculty/profile/kong
- **Jonghyun Lee**, assistant professor of mechanical engineering. Jong joined Iowa State in fall 2017 and has research interests in the areas of additive manufacturing, molten metals, solidification, and CFD. https://www.me.iastate.edu/faculty/profile/jolee

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Upcoming CoMFRE Seminars

- Wednesday, August 28, 10:00 am: Dr. Ian Frigaard, Professor of Mechanical Engineering and Applied Mathmatics at the University of British Columbia; Seminar title: “Why do wells leak, how much do they leak and will multiphase fluid dynamics save the day?” See more.
- Monday, September 16, 10:00 am: Dr. Upendra Natarajan, Professor of Chemical Engineering at the Indian Institute of Technology Madras; Seminar title: "Conformations and equilibrium dynamics of polar polymers in aqueous solution as studied by molecular dynamics simulations" See More.

Recently Awarded Publicly-Funded Grants

Feel free to contact the PI directly if you have any questions on the projects below.

- “Precision Cardiac CT: Development of a Computational Platform for Optimizing Imaging” Adarsh **Krishnamurthy**; Funding Agency – Duke University (NIH-National Heart Lung & Blood Institute); New funding amount $49,579.
- “Non-Contact Creep Characterization of High Temperature Materials for Nuclear Thermal Propulsion” PIs – Jonghyun **Lee**, Pranav **Shrotriya**; Funding Agency - National Aeronautics & Space Administration; New funding amount $38,872.
- “Collaborative Research: Bridging the Gap between Particle-Scale Thermal Transport and Device-Scale Predictions” PI – Shankar **Subramaniam**; Funding Agency - National Science Foundation; New funding amount $196,705.

Recent Journal Publications

Note that CoMFRE affiliates are identified by **bold** names.

- Chen, X., Zhong, W., and **Heindel**, T.J., “Orientation of cylindrical particles in a fluidized bed based on stereo X-ray particle tracking velocimetry (XPTV),” *Chemical Engineering Science*, 20:104-112, 2019. https://doi.org/10.1016/j.ces.2019.03.067.
- Heylmun, J.C., Kong, B., **Passalacqua**, A., and **Fox**, R.O. “A quadrature-based moment method for polydisperse bubbly flows,” *Computer Physics Communications*, 2019. doi:10.1016/j.cpc.2019.06.005.
- Lawrence, A.R., Laktas, J.M., Place, G.J., Jelliss, P.A., Buckner, S.W., and **Sippel**, T.R., “Organically-capped, nanoscale alkali metal hydride and aluminum particles as solid propellant additives,” *Journal of Propulsion and Power*, 1-11, 2019.
- Machicoane, N., Bothell, J.K., Li, D., Morgan, T.B., **Heindel**, T.J., Kastengren, A.L., and Aliseda, A., “Synchrotron radiography characterization of the liquid core dynamics in a canonical two-fluid coaxial atomizer,” *International Journal of Multiphase Flow*, 115:1-8, 2019. https://doi.org/10.1016/j.ijmultiphaseflow.2019.03.006.
- Ray, M., Chowdhury, F., Sowinski, A., Mehrani, P., and **Passalacqua**, A., “An Euler-Euler model for mono-dispersed gas-particle flows incorporating electrostatic charging due to particle-wall and particle-particle collisions,” C*hemical Engineering Science*, 197:327-344, 2019. doi:10.1016/j.ces.2018.12.028
- Yang, X., **Kong**, S.-C. “Adaptive resolution for multiphase smoothed particle hydrodynamics” *Computer Physics Communications*, 239:112–125, 2019.
- Yang, X., Pan, Y., **Kong**, S.-C., Ting, F.C., Lyer, C., Yi, J. “Numerical study of fuel droplet impact on heated surfaces using smoothed particle hydrodynamics method,” SAE Paper 2019-01-0291, 2019.

Recent Conference Publications

- Bothell, J.K., Li, D., Morgan, T.B., **Heindel**, T.J., Machicoane, N., Aliseda, A., and Kastengren, A.L., “Statistical analysis of focused beam radiographs taken from a coaxial airblast spray,” *ILASS-30th Annual*

Conference on Liquid Atomization and Spray Systems, Tempe, AZ, May 12-15, 2019, Submission ID: 10.

- **Heindel**, T.J., Bothell, J.K., Burtnett, T.J., Li, D., Morgan, T.B., Aliseda, A., Machicoane, N., Matusik, K.E., and Kastengren, A.L., "The effect of nozzle electrification on spray formation from an airblast atomizer," *4th Thermal and Fluids Engineering Conference*, Las Vegas, NV, April 14-17, 2019, Paper TFEC-2019-28854.
- Heylmun, J., **Passalacqua**, A., and **Fox**, R.O., "Simulations of large-scale bubble columns using quadrature based moment methods," *Finite Elements in Fluids 2019*, Chicago, IL, March 31-April 3, 2019.
- Heylmun, J., **Passalacqua**, A., and **Fox**, R.O., "Validation of a quadrature-based moment method for polydisperse gas-liquid flows," *International Conference on Multiphase Flows 2019*, Rio de Janeiro, Brazil, May 19-24, 2019.
- Li, D., Bothell, J.K., Morgan, T.B., **Heindel**, T.J., Machicoane, N., Aliseda, A., and Kastengren, A.L., "Measurement of liquid core length of a coaxial two-fluid spray," *ILASS-30th Annual Conference on Liquid Atomization and Spray Systems*, Tempe, AZ, May 12-15, 2019, Submission ID: 25.
- Morgan, T.B., Bothell, J.K., Burtnett, T.J., Li, D., **Heindel**, T.J., Aliseda, A., Machicoane, N., Matusik, K., and Kastengren, A.L., "Optimization of high-speed white beam X-ray imaging for spray characterization," *ILASS-30th Annual Conference on Liquid Atomization and Spray Systems*, Tempe, AZ, May 12-15, 2019, Submission ID: 31.
- Ray, M., Chowdhury, F., Sowinski, A., Mehrani, P., and **Passalacqua**, A., "Euler-Euler model for charge transport in fluidized beds of polyethylene particles," *Fluidization XVI 2019*, Guilin Shangri-La Hotel, Guilin, China, May 26-31, 2019.
- Yang, X., **Kong**, S.-C., Kweon, C.B.M. "Predicting drop impact on heated walls using multiphase SPH with adaptive resolution," 11th *US National Combustion Meeting*, Pasadena, CA, March 24-27, 2019.

If you have questions or news items to suggest, please contact CoMFRE at comfre@iastate.edu

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