
December 2023 CoMFRE Newsletter

Message from the Director

Happy Holidays from CoMFRE! As the year ends, we reflect on our CoMFRE accomplishments, including new projects, publications, and collaborations. Some of the more recent accomplishments are summarized below. During this time of year, I also like to think of the many multiphase flows that are part of the holiday season, from snow falling (this year it's rain for most of us) to the many drink concoctions we may enjoy to powdered sugar being sifted on a sweet treat.

Enjoy the Holiday season with your family and friends!



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

2023 CoMFRE Annual Meeting

The [2023 CoMFRE Annual Meeting](#) was held October 23-24, 2023, at Iowa State University's Alumni Center.

Industry members gathered with collaborating faculty to present updates on shared research and discuss future goals and research for CoMFRE.

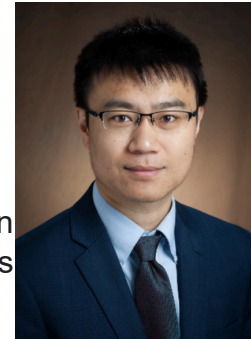
A social hour was held alongside a student poster contest that included [posters](#) from 20 students (winners posted below).

On Tuesday, eight speakers from government, industry, and academia presented on various topics within multiphase flows. In addition to presentations and a poster session, the meeting provided opportunities for networking and interaction among industry representatives, faculty, graduate students, and postdocs.

Welcome Dr. Wenjie Xia to CoMFRE

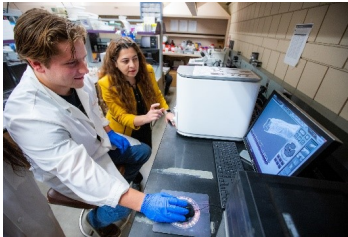
Dr. Wenjie Xia joined Iowa State University in August of 2023 as an Associate Professor in the Department of Aerospace Engineering.

He received his Ph.D. in Civil and Environmental Engineering from Northwestern University in 2016. His research focuses on computational design and understanding of complex behaviors of hierarchical functional materials via multiscale and data-driven modeling. Learn more about Dr. Xia [here](#). A full list of CoMFRE faculty can be found [here](#).



CoMFRE and CoMFRE Affiliates in the News

Advancing “placenta-on-a-chip” technology



CoMFRE affiliate **Nicole Hashemi** and her students have been working for years to develop a "[placenta-on-a-chip](#)" that models how medicines, nutrients, and other substances are passed from mother to fetus.

The placenta-on-a-chip is a thin, rectangular, clear polymer block with two tiny microchannels – just millionths of a meter wide and high – and a porous membrane in between. By pumping fluids through the model, researchers can test how substances such as medicines and nutrients cross the placental barrier from mother to fetus and vice versa.

With support of a new, three-year \$350,000 NSF Mid-Career Advancement grant, Hashemi's team will now work on developing sensing, personalized medicine, and commercialization of the model.

Researchers developing 'revolutionary' multi-material for light-based 3D printing

CoMFRE researchers **Adarsh Krishnamurthy** and **Baskar Ganapathysubramanian** are part of a team combining materials chemistry, computational science, and machine learning to identify and study single resins that can create different materials and properties when exposed to different light wavelengths and exposures. The effort is part of a multi-agency Materials Genome Initiative. More can be found [here](#).

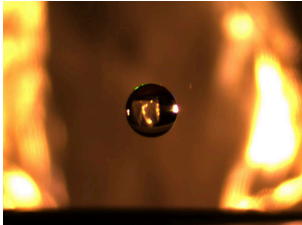
CoMFRE researchers discuss green energy

Rodney Fox, CoMFRE executive director, and **Ted Heindel**, CoMFRE director, discuss how CoMFRE and longstanding industrial research partnerships are advancing sustainable energy innovations – like green hydrogen – in this story by the [Iowa State Daily](#).

CoMFRE researchers use scientific WAND² to suspend solutions in midair

CoMFRE affiliate researcher **John Jonghyun Lee** led a research team that demonstrated the world's first neutron scattering on levitated salt solution droplets up to extreme supersaturation. How'd they do it? With a novel instrument they designed called a Soft Matter Electrostatic Levitator (SEL), integrated into the Department of Energy's Oak Ridge National Laboratory's

High Flux Isotope Reactor's WAND² facility. The new experimental capabilities can be applied to structural studies of many materials, including proteins, colloids, polymers, biominerals, and more. Read more [here](#).



Recent Journal Publications

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

- Ghosh, R., Benti, S.A., and **Juárez, J.**, "Particle-wall hydrodynamic effects on optical trapping viscometry," [Colloids and Surfaces A](#), vol. 682, pg. 132942
- **Heindel, T.J.**, "X-ray flow visualization: Techniques and applications," *Journal of Fluids Engineering*, 146:1, Paper 010801 (2024). <https://doi.org/10.1115/1.4064050>.
- Miah, M.A.K., Zeller, P., **Olsen, M.G.**, and **Juárez, J.**, "Acoustic driven circulation around cylindrical obstructions in micro channels," [Physics of Fluids](#), vol. 35, p. 111701 (2023).

Recent Conference Publications and Presentations

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

- Al-Subaey, M.Y., **Passalacqua, A.**, and **Heindel, T.J.**, "[Quantifying Air Entrainment at the Gas-Liquid Interface in Stirred Tank Reactors](#)," 2023 APS-DFD Meeting, Washington, DC, November 19-21, 2023, Log Number: 1697198.

- Capecelatro, J., Sridhar, A., and **Fox, R.O.**, "Turbulence transport in particle-laden compressible flows," APS-DFD Annual Meeting, Washington, DC
- Ghosh, R., Bental, S., and **Juárez, J.**, "[Hydrodynamic effects for Optical Trapping](#)," 2023 Joint Midwest & Great Lakes Regional Meeting, 2023, St.Charles, MO.
- Ray, M., Sigel, A., **Fox, R.O**, **Heindel, T.J.**, and **Passalacqua, A.**," Validation of a quadrature-based moment method for simulation of bubble columns," AIChE Annual Meeting, Orlando, FL.
- Sigel, A.E., Ray, M., **Fox, R.O.**, **Passalacqua, A.**, and **Heindel, T.J.**, "[Bubble Column Void Fraction and Bubble Size Measurement](#)," 2023 AIChE Annual Meeting, Orlando, FL, November 5-10, 2023, Abstract #664951.

Recent Invited Presentations:

- **Fox, R.O.:**
 - *Kinetic-based, multiscale Eulerian models for polydisperse multiphase flows*, Invited Lecture, 2023 International Symposium on Multiphase CFD for Sustainable Engineering, Shanghai Institute for Advanced Study, Zhejiang University, Shanghai, China.
 - *Turbulence modeling of compressible disperse multiphase flows*, Keynote Lecture, IUTAM Symposium on Turbulent Structure and Particles-Turbulence Interaction, Lanzhou University, Lanzhou, China.
 - *Kinetic-based, multiscale Eulerian models for polydisperse multiphase flows*, Invited Lecture, Guangdong Technion - Israel Institute of Technology, Shantou, China.

Student Honors and Awards

- 2023 CoMFRE Annual Meeting Student Poster Contest Awardees:
 - People's Choice Award - \$400 - Fynn Reinbacher, "[Holography of Fuel Spray Break-up on Hot Surfaces](#)" Advisor: **James Michael**
 - 1st Place - \$300 - Libiba Imtiaz, "[Examining Primary Atomization of Blood Break-ups using Fan Spray](#)" Advisor: **James Michael**
 - 2nd Place - \$200 - Bella Guyll, "[In-Line Manipulation of Droplet Evaporation in Aerosol Jet Printing](#)" Advisor: **Ethan Secor**
 - 3rd Place - \$100 - MD Sadiqul Islam, "[Condensation-based Growth of Nanoparticles for Real-time Inertial-based Capture and Biothreat Sensing](#)" Advisors: **Todd Kingston and Pranav Shrotriya**



Recent Degrees Granted to Students Working on Multiphase Projects

- Yongsuk Cho, Ph.D., August 4, 2023, "Multi-scale simulations of biomass particle pyrolysis using Lattice Boltzmann method" - Co-advised by **James Michael** and Song-Charng Kong (Texas Tech University)
- Justin LaJoie, PhD, October 5, 2023, "Microwave ignition and combustion control of 3D printed solid rocket propellant via binder additives, macro-, and micro-scale metal and metal oxides," Co-advised by Travis Sippel (Mizzou) and **James Michael**.

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