September 2023 CoMFRE Newsletter

Message from the Director

Welcome back to another fall semester filled with multiphase flows, from falling leaves and grain harvesting to rain and the eventual snowfall. CoMFRE is busy finalizing our annual meeting (October 23-24; see below). CoMFRE students are also busy assembling posters for our student poster competition. This will be an excellent way for you to also see the breadth of multiphase flow research in which our students are involved. We have an excellent line up of invited speakers from national labs, industry, and ISU. We look forward to seeing you at the meeting.

We continue to look for ways to expand CoMFRE's influence. We hope to add additional ISU faculty to the CoMFRE ranks in the coming months; we will introduce you to those individuals as they are added. We continue to explore adding additional member companies. I would also like to hear from you if you have ideas to expand CoMFRE's influence on campus and beyond.

Enjoy the multiphase flows of fall.

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

Save the Date - 2023 CoMFRE Annual Meeting

The 2023 CoMFRE Annual Meeting will take place on October 23-24, 2023 at the Iowa State Alumni Center. Confirmed speakers include representatives from Argonne National Lab, John Deere, Altair, Spraying Systems Co., Los Alamos National Laboratory, and Iowa State. For more information and registration, follow this LINK.

CoMFRE and CoMFRE Affiliates in the News

Expanding 3D force measurements

Jacqueline Reber, CoMFRE researcher and associate professor of geological and atmospheric sciences, is expanding her work in 3D force visualization and quantification with a grant from Iowa State's Frontier Science Fund. Reber's new project is developing a 3D photoelastic measurement device to advance understanding of granular flows. Read more here.

CoMFRE researchers developing new approach to maintaining colloidal filtration systems

CoMFRE faculty **Jaime Juarez**, associate professor of mechanical engineering, and **Michael Olsen**, professor of mechanical engineering, have a new NSF project to study an innovative approach to maintaining colloidal filtration systems. Juarez and Olsen are exploring using acoustic waves to break apart colloid buildup and/or prevent buildup from developing. Read the full article here.

Ted Heindel receives ASME 2023 Freeman Scholar Award

Theodore (Ted) J. Heindel, director of CoMFRE, the Bergles Professor of Thermal Science, and University Professor of mechanical engineering, received the 2023 Freeman Scholar Award from the American Society of Mechanical Engineers (ASME), in recognition of his exceptional contributions to the field of fluids engineering, particularly X-ray flow visualization.

As the 2023 Freeman Scholar, Heindel is writing a review on "X-ray Flow Visualization: Techniques and Applications," and which was recently submitted to the *Journal of Fluids Engineering* for review. He also recently presented a plenary lecture on the same topic at the 2023 ASME-JSME-KSME Fluids Engineering Division Summer Meeting in Osaka, Japan. The full story can be found here.

Faculty Honors and Awards

- **Nicole Hashemi**, along with Reza Montazami, received a patent for "Conductive Graphene Matrix-Encapsulated Cells"
- **Ping He**, assistant professor of aerospace engineering, named a Michael and Denise Mack 2050 Challenge Scholar

- **Ming-Chen Hsu** received a patent for “Methods for Creating Sinus-Matched Aortic Valves”
- **Hui Hu**, Martin C. Jischke Professor in Aerospace Engineering and professor of aerospace engineering, received the College of Engineering D.R. Boylan Faculty Award for Research
- **Dennis Vigil**, department chair of chemical and biological engineering, named the Reginald R. Baxter Endowed Department Chair in Chemical and Biological Engineering
- **Kejin Wang**, Wilson Engineering Professor and professor of civil, construction and environmental engineering was named Anson Marston Distinguished Professor in Engineering, Iowa State’s highest academic honor

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Recently Funded Research Awards

- “ONR MURI: Combustion of Solid Fuels in High Enthalpy Flow” PI: **James Michael**. Funding Agency: Virginia Polytechnic Institute & State University; New funding Amount $94,285
- “Acoustically Activated Trapping for Colloidal Filtration: A Multiscale Experimental Investigation using Laser-based Optical Diagnostics” PI: **Jaime Juarez Co-PI: Michael Olsen.** Funding Agency: National Science Foundation; New Funding Amount $320,256
- “Modeling the Transport of Pharmaceutical Agents Across the Placental Barrier” PI: **Nicole Hashemi**. Funding Agency: National Science Foundation; New Funding Amount $350,000

Recent Journal Publications

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

- Aykar, S., Ouedraogo, L., Petersen, I., Trznadel, m., Alimoradi, N., Montazami, R., Brockman, A., **Hashemi, N.**, "Automated patterning of human brain endothelial cells on microstructures using a microfluidic manufacturing approach: An in vitro study," *Journal of Advanced Manufacturing and Processing* (e10169)
- Boniou, V., and **Fox, R.O.,** “Shock—particle-curtain-interaction study with a hyperbolic two-fluid model: Effect of force models,” *International Journal of Multiphase Flows* 104591 (2023).
- Farsoiya, P., Z. Liu, A. Daiss, **Fox, R.O.**, L. Deike, “Role of viscosity in turbulent drop break-up,” *Journal of Fluid Mechanics* **972,** A11 (2023).
- **Fox, R.O.**., “A turbulence model for compressible disperse multiphase flows,” *Proceeding of the IUTAM Symposium*, Ed. X. Zheng (2023).
- Laurent, F., and **Fox, R.O.**, “Evaluation of the 1-D hyperbolic quadrature method of moments for non-equilibrium flows,” *ESAIM: Proceedings and Surveys* (2023).

- Pemathilaka, R., **Hashemi, N**., Placenta-on-a-chip: "Response of neural cells to pharmaceutical agents transported across the placental barrier" *Innovation and Emerging Technologies* (Vol.10)

Recent Conference Publications and Presentations

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

- **Pillers, R.A.,** and **Heindel, T.J**., "3D Bubble Plume Void Fraction using X-ray Computed Tomography," AJK FED2023: ASME-JSME-KSME Joint Fluids Engineering Conference, Osaka, JAPAN, July 9-13, 2023.
- Posey, J. W., **Fox, R.O.**, and Houim, R. W. "Simulations of explosively dispersed polydisperse aluminum powders." 23rd Biennial Conference of the APS Topical Group on Shock Compression of Condensed Matter (SHOCK23), 2023, Chicago, IL.
- Xiang, Z., Chen, X., and **Heindel, T.J.,** "Study of the Three-dimensional Characteristics of Jets in a Spout-Fluidized Bed Based on XCT," AJK FED2023: ASME-JSME-KSME Joint Fluids Engineering Conference, Osaka, JAPAN, July 9-13, 2023.

Recent Invited Presentations:

- **Fox, R.O.** "Recent advances in kinetic-based models for polydisperse multiphase flows," Invited Lecture, 50th Anniversary of International Journal of Multiphase Flow, TU Vienna, Austria, August 30 – September 1, 2023.
- **Heindel, T.J.,** "Visualizing Multiphase Flows with X-rays," Invited Lecture, 50th Anniversary of International Journal of Multiphase Flow, TU Vienna, Austria, August 30 – September 1, 2023.
- **Heindel, T.J**., "X-ray Flow Visualization: Techniques and Applications," AJK FED2023: ASME-JSME-KSME Joint Fluids Engineering Conference, Osaka, JAPAN, July 9-13, 2023 (invited keynote).

Student Honors and Awards

Recent Degrees Granted to Students Working on Multiphase Projects

- **Roy Pillers**, PhD Mechanical Engineering, "Experimental Analysis of Plunging Liquid Jet Systems using Backlit and X-ray Imaging," advised by **Ted Heindel**.
- **Lionel Ouedraogo**, MS Mechanical Engineering, "Sensor-integrated organ-on-a-chip platform for real-time impedance spectroscopy of neural cells" Advised by **Nicole Hashemi**

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