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## **December 2022 CoMFRE Newsletter**

### **Message from the Director**

The semester has ended, and another year is coming to a close. The semester has been busy with our first in-person annual meeting in 3 years and many conferences that are also now in-person. It is nice to see colleagues again face-to-face. CoMFRE faculty and students have been busy too, and you can read about some of their successes below. As we start the new year and spring semester, CoMFRE will be hosting several seminar speakers as the faculty continue to expand their multiphase flow work. You will hear about some of these efforts in upcoming newsletters.

I always like this time of year with the many examples of multiphase flows, from snow falling and plowing to mixing cookie batter and enjoying the many treats that are available.

Don't eat too much but still enjoy the holiday season!



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



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## **2022 CoMFRE Annual Meeting**

The 2022 CoMFRE Annual Meeting was held October 24-25, 2022. On Monday, industry members, along with collaborating faculty, gathered in a closed meeting to present updates on shared research and to discuss future goals and research for CoMFRE. Following the closed meeting, a social hour featured the student poster contest and discussion. Awards were presented (see below for more), with 18 posters presented.

On Tuesday, speakers from government, industry, and academia addressed a group of about 50. In addition to presentations and a poster session, the meeting provided opportunities for networking and interaction among industry representatives, faculty, graduate students, and postdocs.

## CoMFRE and CoMFRE Affiliates in the News

### Icing discoveries receive AIAA best paper honors

A paper published by CoMFRE affiliate **Hui Hu**, Martin C. Jischke Professor in Aerospace Engineering, and three of his former Ph.D. students has been selected for the [2022 AIAA Gas Turbine Engine Best Paper Award](#) by the American Institute of Aeronautics and Astronautics' (AIAA) Gas Turbine Engines Technical Committee.

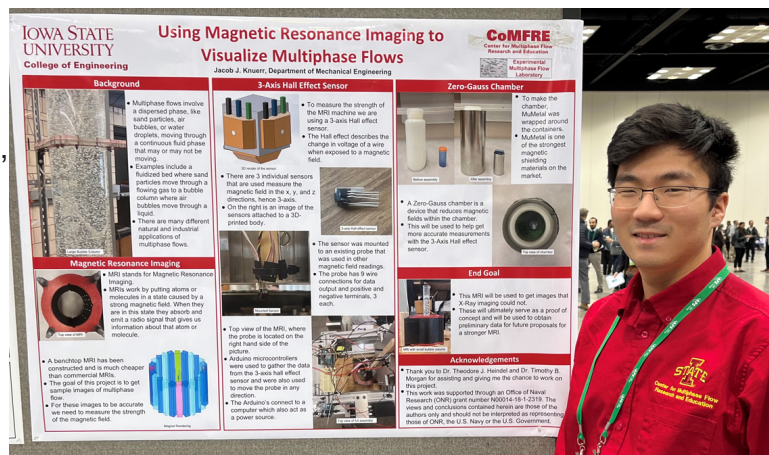
The paper, "An Experimental Study on the Dynamic Ice Accretion Process over the Surfaces of the Rotating Fan Blades of an Aero-Engine Model" (AIAA 2022-2435), involves an experimental campaign conducted to study dynamic ice accretion on rotating aeroengine fan blades and evaluation of the icing-induced performance degradation to the fan rotor for the development of more effective and robust anti-/deicing strategies to ensure safer and more efficient operation of aeroengines in cold weather. Please read more [here](#).

### Undergrad CoMFRE research leads to national conference competition

**Jacob Knuerr** is building his one-of-a-kind multiphase flow research skills and connecting with multiphase scholars from across the world as an undergraduate research assistant working with faculty mentor **Ted Heindel**, CoMFRE director, University Professor, and the Bergles Professor of Thermal Science in the Department of Mechanical Engineering.

"Even though I'm an undergrad, Dr. Heindel gives me liberty, treats me like a grad student and doesn't restrict my learning," Knuerr said, a junior majoring in mechanical engineering. "He's helped me hone my technical skills using various equipment in his lab."

Alongside Heindel, Knuerr's lab peers have helped expand his knowledge in electronics, programming, X-ray technology and high-speed imaging. Working in Heindel's lab has provided major opportunities: attending research seminars, competing in poster competitions, accessing internships, and presenting his research at the 75th



Annual Meeting of the American Physical Society – Division of Fluid Dynamics.  
Read more about Jacob [here](#).

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## Faculty Honors and Awards

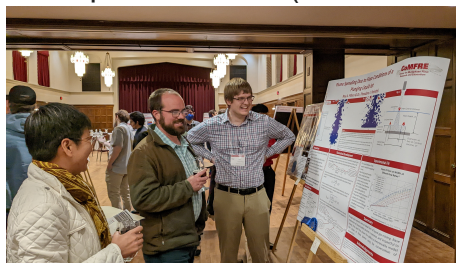
### **Ted Heindel to receive the 2023 ASME Freeman Scholar Award**

It was recently announced that Ted Heindel will receive the 2023 ASME Freeman Scholar Award. The American Society of Mechanical Engineers Freeman Scholar Award is given to a person with significant expertise in fluids engineering who can provide a comprehensive and timely review article for the *Journal of Fluids Engineering* and present a plenary lecture at the Fluids Engineering Division Summer Meeting. Ted will write a review paper this spring focusing on “X-raying Multiphase Flows.” He will formally receive the award when he gives a plenary lecture on the same topic at AJK FED2023 (ASME-JSME-KSME Joint Fluids Engineering Conference) in Osaka, Japan, July 9-13, 2023.

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## Student Honors and Awards

- **Kumar Saurabh** received the Graduate Research Excellence Award from mechanical engineering. Advisors: **Adarsh Krishnamurthy** and **Baskar Ganapathysubramanian**.
- **Jacob Knuerr** received 1<sup>st</sup> place, Undergraduate Student Poster Competition at the 2022 CoMFRE Annual Meeting for his entry “Using Magnetic Resonance Imaging to Visualize Multiphase Flows” (Advisor: **Theodore J. Heindel**)
- **Roy Pillars** received 1<sup>st</sup> place, Graduate Student Poster Competition at the 2022 CoMFRE Annual Meeting for his entry “Plume Spreading Due to Floor Conditions of a Plunging Liquid Jet” (Advisor: **Theodore J. Heindel**)
- **Fynn Reinbacher** received 2<sup>nd</sup> place, Graduate Student Poster Competition at the 2022 CoMFRE Annual Meeting for his entry “Pulsed microwave energy deposition in a sodium seeded micro-channel detonation” (Advisor: **James Michael**)
- **Krishnamurthy Ravichandar** received 3<sup>rd</sup> place, Graduate Student Poster Competition at the 2022 CoMFRE Annual Meeting for his entry “Droplet Breakage Probability in Turbulent Liquid-Liquid Emulsions” (Advisors: **Mike Olsen** and **Dennis Vigil**)



## Recent Degrees Granted to Students Working on Multiphase Projects:

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

- Saurabh Aykar, Ph.D., “Microfluidic Manufacturing of Hollow Polymer Microfibers as a 3D Scaffold for Mimicking the Blood Brain Barrier in-vitro,” Advisor: **Nicole Hashemi**.
- Timothy C. Dahlstrom, M.S., Department of Mechanical Engineering, “Analyzing White Beam Images of an Airblast Atomizer Under Various Ambient Pressures,” Advisor: **Theodore J. Heindel**.
- Anthony LoCurto, PhD., “Thermometry of post-detonation fireball environments,” Advisor: **James Michael**

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## **Recent Journal Publications**

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

- Balu, A., Rajanna, M.J., Khristy, J., Xu, F., **Krishnamurthy, A.**, **Hsu, M.-C.**, “Direct immersogeometric fluid flow and heat transfer analysis of objects represented by point clouds,” *Computer Methods in Applied Mechanics and Engineering*, 404(115742), 2023.
- Balu, A., Sarkar, S., **Ganapathysubramanian, B.**, **Krishnamurthy, A.**, “Physics-aware machine learning surrogates for real-time manufacturing digital twin,” *Manufacturing Letters*, 34:71–74, 2022.
- Belekar, V.V., Murphy, E.J., **Heindel, T.J.**, Nere, N.K., and **Subramaniam, S.**, “Modeling Multiphase Heat and Mass Transfer in an Agitated Filter Dryer by Integrating Experiment, Computations, and Analytical Solutions,” *Pharmaceutical Research*, 39, pp. 1971–1990, 2022.  
<https://doi.org/10.1007/s11095-022-03382-z>.
- Beringer, C.K., Morgan, T.B., Kastengren, A.L., and **Heindel, T.J.**, “Noninvasive Imaging of a Liquid Jet,” *ASME Journal of Fluids Engineering*, 145:2 Paper 021404, 2023.  
<https://doi.org/10.1115/1.4056130>.
- Mineroff, J., Pokuri, B.S., **Ganapathysubramanian, B.**, **Krishnamurthy, A.**, “Optimization framework for patient-specific modeling under uncertainty,” *International Journal for Numerical Methods in Biomedical Engineering*, 2022, Accepted.
- Rade, J., Zhang, j., Sarkar, S., **Krishnamurthy, A.**, Ren, J., Sarkar, A., “Deep learning for live cell shape detection and automated AFM navigation,” *Bioengineering*, 9(10):522, 2022.
- Shah, H., Ghadai, S., Gamdha, D., Schuster, A., Thomas, I., Greiner, N., **Krishnamurthy, A.**, “GPU-accelerated collision analysis of vehicles in a point cloud environment,” *IEEE Computer Graphics and Applications*, 42(5):37–50, 2022.
- Tan, K., Gao, B., Yang, C.-H., Johnson, E. L., **Hsu, M.-C.**, **Passalacqua, A.**, **Krishnamurthy, A.**, **Ganapathysubramanian, B.**, “A computational framework for transmission risk assessment of aerosolized particles in classrooms,” *Engineering with Computers*, 2022, In Print.

## **Recent Conference Publications and Presentations**

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

- Dahlstrom, T.C., Morgan, T.B., Kastengren, A.L., and **Heindel, T.J.**, “Near-Field Spray Characterization in a Pressurized Environment using High-Speed X-ray Imaging,” *2022 APS-DFD Meeting*, Indianapolis, IN, November 20-22, 2022, Log Number: DFD22-646920.
- Herron, E., Jignasu, A., Rade, J., Lee, X.Y., Balu, A., **Krishnamurthy, A.**, Sarkar, S., “Fast unsupervised generative design for structural topology optimization,” *AAAI workshop on AI for Design and Manufacturing (ADAM)*, 2022.
- Lee, X. Y., Balu, A., Pokuri, B.S., **Krishnamurthy, A.**, Sarkar, S., Ganapathysubramanian, B., “Inverse design of microstructures via generative networks for organic solar cells,” *AAAI workshop on AI for Design and Manufacturing (ADAM)*, 2022.
- Miles, Z., Jignasu, A., Balu, A., **Krishnamurthy, A.**, Chakrapani, S.K., “Ultrasonic digital twin of additively manufactured samples,” *Review of Progress in Quantitative Nondestructive Evaluation*, 98255, 2022.
- Prasad, A.D., Jignasu, A., Jubery, Z., Sarkar, S., **Ganapathysubramanian, B.**, Balu, A., **Krishnamurthy, A.**, “Deep implicit surface reconstruction of 3D plant geometry from point cloud,” *AAAI workshop on AI for Agriculture and Food Systems (AIAFS)*, 2022.
- Rade, J., Balu, A., Herron, E., Jignasu, A., Botelho, S., Adavani, S., Sarkar, S., **Ganapathysubramanian, B.**, **Krishnamurthy, A.**, “Multigrid distributed deep CNNs for structural topology optimization,” *AAAI workshop on AI for Design and Manufacturing (ADAM)*, 2022.
- Saraeian, M., **Krishnamurthy, A.**, **Hsu, M.-C.**, “Effect of non-sinus-matching bioprosthetic aortic valve design on coronary flow,” *World Congress on Computational Mechanics*, Page 757, 2022.

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