
December 2024 CoMFRE Newsletter

Message from the Director

The holidays are here and we are all winding down for a break. The semester break gives faculty and graduate students time to catch up on research, course preparation, and time with family. There are also many multiphase flow activities around the holidays – from cookie making and decorating to special holiday treats – please enjoy them!

The new year is bound to bring about changes for CoMFRE faculty with new research directions, new projects, and new courses. Our CoMFRE research remains strong with a variety of projects covering traditional multiphase flows to broad applications of particulate and granular flow; many of these areas are highlighted below with the student poster award winners from our 2024 CoMFRE Annual Meeting.

I hope you have a great Holiday season and partake in as many multiphase flow opportunities as you can!



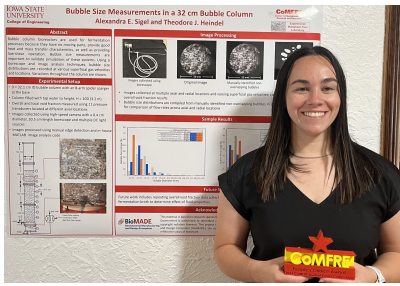
Theodore (Ted) J. Heindel
Director, Center for Multiphase Flow Research and Education
University Professor and Bergles Professor of Thermal Sciences

2024 CoMFRE Annual Meeting The 2024 CoMFRE Annual Meeting was held October 21-22, 2024, at the Iowa State Alumni Center. The conference began with a student poster contest, reception and dinner. Invited speakers included representatives from AFRL Reginal Network-Midwest, BioMADE, and Naval Surface Warfare Center.

Poster contest winners are listed below along with some information about the students.

Poster Contest Winners

People's Choice Award Winner: Alex Sigel



Poster Title: "Bubble Size Measurement in a 32 cm Bubble Column"

Major: Mechanical Engineering

Degree in Progress: Masters of Science

Advisor: **Dr. Ted Heindel**

What made you want to work in this area?

Thermal sciences have always been of interest to me since I obtained my undergraduate degree

here at Iowa State. When I decided to pursue a secondary degree, multiphase flows piqued my interest as they provide the opportunity to do physical experiments.

Favorite part of the project: Problem solving. Over the course of this project, there have been many unanticipated challenges that required unique solutions.

Plans after graduation: Moving to the Twin Cities to begin full time work!

1st Place Winner: Mazyar Etemadzadeh

Poster Title: "Soot Characterization and Decontamination Challenges in Firefighter Gear"

Major: Biotechnology- Designing detergent enzyme

Degree in progress: PhD program

Advisor(s): **Dr. Guowen Song** and Dr. Rui Li

What made you want to work in this area?

As an interdisciplinary project, helping firefighters mitigate the health risks of toxic and carcinogenic chemical exposure through developing protective clothing (PC) decontamination protocols deeply aligns with my passion for impactful research. Additionally, understanding the contamination nature—such as the bonding behavior of chemicals with fabric structure and the size and shape of soot particles—is critical to developing effective decontamination methods.

What was your favorite part of this project?

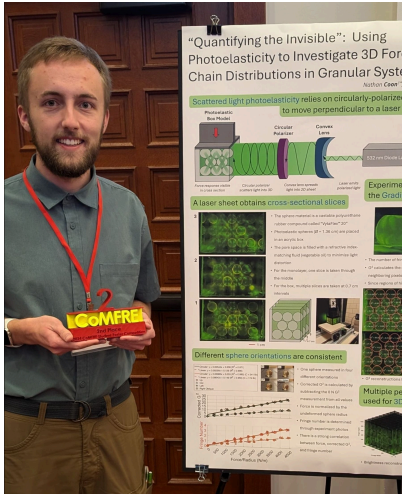
My favorite part has been establishing the contamination and penetration methods to simulate real-world conditions. By replicating the contamination levels firefighters experience, we can better understand how their clothing absorbs toxic substances that lead to acute and chronic health issues.

What are your plans for after graduation?

After graduation, I plan to pursue post-doctoral research in related areas, focusing on the development of advanced materials, including nano and bio-based solutions, to reduce health risks in various occupational settings and public applications.



Second Place Winner: Nathan Coon



Poster Title: “Quantifying the Invisible: Using Photoelasticity to Investigate 3D Force Chain Distributions in Granular Systems”

Major: Geology

Degree in progress: Master of Science

Advisor: **Dr. Jacqueline Reber**

What made you want to work in this area?

I found it interesting how little we understand about granular systems despite them being everywhere

What was your favorite part of this project?

Getting to invent my own methods and materials for a new way to run experiments

What are your plans for after graduation? I plan

to work full-time in the mining industry

Third Place Winner: Bella Guyll

Poster Title: “Saturating the Sheath Gas in Aerosol Jet Printing”

Major: Mechanical Engineering

Degree in progress: PhD

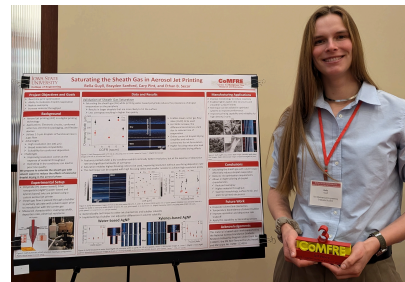
Advisor(s): **Dr. Ethan Secor** and Dr. Cary Pint

What made you want to work in this area? I was

drawn to additive manufacturing because it combines many mechanical engineering elements: fluids, thermodynamics, and mechanics. Aerosol jet printing’s ability to print high-resolution functional materials on complex surfaces makes it ideal for advancing printed electronics and I’m excited to explore its potential to create more efficient technologies.

What was your favorite part of this project? I really enjoy the hands-on aspects such as getting to design and build various printer components.

What are your plans for after graduation? I have not decided yet. I am considering going into electronics fabrication or continuing in academia with a post doc position.



Recent Funded Research Awards

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

- “Decoupling the Role of Gravity in Processing Soft Matter Systems”
Nicole Hashemi, \$402,262, **DOD-Air Force Office of Scientific Research**.

Recent Journal Publications

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

- Chen, X., Zhong, W., Liu, S., and **Heindel, T.J.**, “X-ray Computed Tomography (XCT) Study of Jetting in a Fluidized Bed: Measurement Method Development and Single Component Fluidization,” *Advanced Powder Technology*, 35(11): Paper 104681, 2024. <https://doi.org/10.1016/j.apt.2024.104681>
- Watkins, L., **Mukherjee, S.**, Tithof, J. “Dynamics of Waste Proteins in Brain Tissue: Numerical Insights into Alzheimer's risk Factors” *Phys. Rev. E* 110, Paper 034401, 2024. <https://doi.org/10.1103/PhysRevE.110.034401>

Recent Conference Publications and Presentations

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

- Miah, M.A.K., UI-Islam, M., Ghosh, R., Tangudu, C., **Olsen, M.**, **Juarez, J.** “Microfluidic Mixing Mediated by Acoustic Streaming around Microscale Obstacles” 77th Annual Meeting of the Division of Fluid Dynamics, APS-DFD, Salt Lake City, Ut, November 24-26, 2024 [Abstract: A18.00002](#)
- **Mukherjee, S.** “Modeling interstitial fluid flow induced by traveling waves in the brain” 77th Annual Meeting of the Division of Fluid Dynamics, APS-DFD, Salt Lake City, UT, November 24-26, 2024, [Abstract: L06.00008](#)
- **Olsen, M.**, Miah.A.K, M., **Juarez, J.** “Acoustic streaming flow driven about an array of sharp-edged obstacles” 77th Annual Meeting of the Division of Fluid Dynamics Salt Lake City, UT, November 24-26, 2024 [Abstract: L11.00008](#)
- Sarkar, D., **Mukherjee, S.** “Determining the effective Taylor dispersion in an annulus with a pulsatile inner boundary” 77th Annual Meeting of the Division of Fluid Dynamics, APS DFD, Salt Lake City, UT, November 24-26, 2024 [Abstract: L06.00011](#)

Recent Graduates

- Nicholus Clinkinbeard, PhD in Mechanical Engineering. Thesis Title: “Deep Neural Network-Driven Enhancement of the Microfiber Design and Fabrication Process” advised by **Nicole Hashemi**
- Jeremy Rurup, PhD in Mechanical Engineering. Thesis Title: “Addressing Process Variation in Aerosol Jet Printing and Accelerating Conformal Electronics Manufacturing” Advised by **Ethan Secor**

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Center for Multiphase Flow Research and Education · 537 Bissell Rd · Comfre 2624 Howe Hall · Ames, IA 50011-1096 · USA

