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## **March 2023 CoMFRE Newsletter**

### **Message from the Director**

Welcome to another CoMFRE newsletter! It looks like spring has sprung, at least in Ames. We can all enjoy the many multiphase flow of spring, from spring rain (and snow!) to seed planting. As I look out my office window, I also see the many multiphase flows found when constructing a new campus building, from earth being dug and dumped into dump trucks hauling it away to other trucks dumping and spreading gravel and pouring concrete. Take a moment to appreciate the many multiphase flows around you.

Enjoy your spring!



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



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## **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. Please put a hold on your calendar. More information to follow.

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## **Recent CoMFRE Seminars**

### **Dr. Christopher Tyler, Cargill**

On March 2<sup>nd</sup>, Dr. Tyler presented “Validation of a Simple Breakup and Coalescence Model in an Eulerian-Lagrangian Framework and Applications of the Model in Industrial Systems”

**Abstract:**

When modeling liquid-gas systems in an Eulerian-Lagrangian framework, it is possible to model the bubble size distribution through a simple set of rules for the breakup and coalescence, related to the local turbulent intensity, applied to each Lagrangian particle. We will present work validating such models against lab scale and industrial scale systems. We will discuss several applications of this model to industrially relevant systems, highlighting the process learnings and process improvements that this approach has produced.

**Upcoming CoMFRE Seminars**

**Dr. Noelia Gudino**, Genomatica

April 13, 2023, 9:00 AM 2004 Black Engineering

Title: "Multiphase Flow Challenges in Industrial Biotechnology"

Geno is developing and scaling sustainable production processes using plant- or waste-based feedstocks instead of fossil fuels. Geno's technologies commercialize sustainable alternatives to commonly used ingredients and materials across several industries including beauty, apparel, automotive, home and personal care, packaging and functional foods and beverages.

Fermentation is at the core of our technologies: we utilize microorganisms to convert feedstocks into useful materials. Commercial fermentation processes involve complex systems of interrelated physical and chemical phenomena. This includes the presence of solid, liquid, and gaseous phases that continuously interact with each other. Furthermore, once a given compound of interest has been produced through fermentation, it must be recovered from the aqueous mixture and purified to industrial specifications. This involves several steps with different phases and interactions.

In this talk, I will describe some multi-phase challenges encountered in bioprocess development, commercialization and operations. Additionally, I will provide an overview of the approach that Geno applies to mitigate the risks linked to those challenges, especially in fermentation scale-up.

**Dr. Martin Obligado**, LEGI, France

April 20, 2023, 9:00 AM 2004 Black Engineering

Title: "Hydrodynamics of bubble columns operated in the heterogeneous regime"

Martin Obligado is an associate professor (maître de conférence) at LEGI since September 2016. He defended his PhD (also in LEGI) in 2013 and then completed a three-year postdoc in Imperial College, London. He is an expert on the experimental characterization and theoretical modelling of single and two-phase non-canonical turbulent flows. His current research topics include the study of gravitational settling of particles in turbulence, their clustering, and the

hydrodynamics of bubble column reactors. He also works on modelling and the formation of free-shear turbulent flows, jets, fundamental turbulence theory and environmental flows.

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## **CoMFRE and CoMFRE Affiliates in the News**

### **Faculty unlocking cell communication using bionics**

**Nicole Hashemi**, CoMFRE affiliate faculty member, is co-PI on a new project exploring a novel approach to investigate cells' bioelectric activities, funded by the DOD Army Research Office.

The full story can be found [here](#).

### **Stormwater flow: New project seeks more efficient and equitable public stormwater infrastructure**

**Chris Rehmman**, a CoMFRE affiliate faculty member, leads a new stormwater management project that received Iowa State University Strategic Plan Presidential jump-start seed funding. The project will work to improve planning and decision-making processes for more equitable and effective public stormwater infrastructure. Please read more [here](#)

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## **Faculty Honors and Awards**

### **CoMFRE affiliate has been named an Iowa State College of Engineering Michael and Denise Mack 2050 Challenge Scholar**

**Ping He**, assistant professor of aerospace engineering, will use the award to support research on the design optimization of next-generation electric aircraft for on-demand urban air taxis. Read more [here](#)

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## **Recent Journal Publications**

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

- Balu, A., Rajanna, M., Khristy, J., Xu, F., **Krishnamurthy, A.**, and **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.
- Nadeem, N., **Subramaniam, S.**, Nere, N.K., and **Heindel, T.J.**, "A Particle Scale Mixing Measurement Method using a Generalized Nearest Neighbor Mixing Index," *Advanced Powder Technology*, 34:2 Paper 103933, 2023. <https://doi.org/10.1016/j.apr.2022.103933>
- Tan, K., Gao B., Cheng-Hau Yang, C-H., Johnson, E.J., **Hsu, M-C.**, **Passalacqua, A.**, **Krishnamurthy, A.**, and **Ganapathysubramanian, B.**, "A Computational Framework for Transmission Risk Assessment of Aerosolized Particles in Classrooms," *Engineering with Computers*, 2023.

- Zhu, K., Barkley, S., **Sippel, T.R.**, and **Michael, J.B.**, “Emission Thermometry of Microwave-Assisted Alkali-Doped Propellant Combustion,” *Combustion and Flame*, 251, 112704 (2023).  
[doi.org/10.1016/j.combustflame.2023.112704](https://doi.org/10.1016/j.combustflame.2023.112704)
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**Our email address is:** [comfre@iastate.edu](mailto:comfre@iastate.edu)

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

