

September, 2021, CoMFRE Newsletter

CoMFRE <comfre@iastate.edu>

Thu 9/30/2021 8:19 AM

To: Clark, Sandra [E R I] <sclark@IASTATE.EDU>

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September 2021 CoMFRE Newsletter

Message from the Director

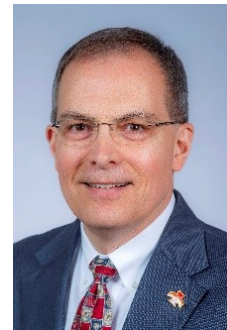
Welcome to another CoMFRE newsletter. Fall is in the air and all the multiphase flows associated with fall are upon us, from leaf blowing to harvest to even the crowds “flowing” through the turnstiles at college football games. At ISU, we are well into our fall semester of 100% in-person learning. It is a significant change from last year when most of our classes were provided online. Although COVID-19 is still a concern, the Iowa Board of Regents would like all Regent Universities (ISU included) to provide our students will a more traditional college experience, including in-person classes. So far, we have not had a significant outbreak that I am aware of.

As the semester continues, we are planning for our Fall CoMFRE meeting, which will be held virtually on October 26 (details below). We look forward to everyone joining the Zoom meeting and hope we can meet in person next year.

Enjoy the fall weather,



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



SAVE THE DATE: CoMFRE Annual Meeting, October 26, 2021

The 2021 CoMFRE Symposium and Member Meeting will be a one-day virtual event held on Tuesday, October 26th from 8AM - 2PM. Industry members will receive updates on shared research and meet with CoMFRE faculty and students to discuss ongoing research and goals for the center.

This year CoMFRE Students and Postdocs will participate in a Single Slide Research Pitch Competition with a brief oral presentation to accompany their single slide, and cash prizes will be awarded to the top three entries.

ISU Faculty will also present recent findings and future plans from selected federal grants.

Please register for the October 26 conference (at no cost) so we have an estimate on the attendance. The registration link is <https://bit.ly/comfre18502>.

The zoom connection details include:

[https://iastate.zoom.us/j/98666193005?
pwd=V3UxaDY4ODIyU0ZrK0lXeTVRR2JjUT09](https://iastate.zoom.us/j/98666193005?pwd=V3UxaDY4ODIyU0ZrK0lXeTVRR2JjUT09)

Or, go to <https://iastate.zoom.us/join>

and enter meeting ID: 986 6619 3005 and password: 815800

To Join from dial-in phone line:

Dial: +1 312 626 6799 or +1 646 876 9923

Meeting ID: 986 6619 3005

Participant ID: Shown after joining the meeting

International numbers available: <https://iastate.zoom.us/u/aoHwuamfH>

CoMFRE and CoMFRE Affiliates in the News

From CoMFRE Grad Student to Notre Dame Faculty

Emily Johnson completed a Ph.D. in mechanical engineering and wind energy science and policy this past summer, researching alongside associate professor **Ming-Chen Hsu** in the Computational Fluid Structure Interaction Laboratory. This fall, Johnson joined the faculty of the University of Notre Dame. Johnson says Hsu's research group and CoMFRE gave her the opportunity to work in an interdisciplinary space and culture. Her experience in her Ph.D. studies required collaboration with many different disciplines, building experience and skills that she will be using in her new position at Notre Dame.

<https://news.engineering.iastate.edu/2021/08/27/emily-johnson-from-cyclone-engineering-ph-d-to-notre-dame-faculty/>

Ground-shifting research: Soil-Machine Dynamics Laboratory

The Iowa State Soil-Machine Dynamics Laboratory (SMDL), directed by assistant professor **Mehari Tekeste**, is one of only a few of its kind in all of North America, giving Iowa State researchers, including CoMFRE affiliate faculty, students, and industry partners unique access to soil testing that will shape the future. The SMDL is home to three major types of equipment with state-of-the-art measurement and control. This technology can be used in engineering research programs for agriculture, construction, mining and extraterrestrial machine applications.

<https://news.engineering.iastate.edu/2021/07/06/ground-shifting-research-soil-machine-dynamics-laboratory/>

CoMFRE graduate student earns prestigious DoD SMART Scholarship

Justin Lajoie, a mechanical engineering graduate student working with **Travis Sippel** in multiphase flows, has received the Department of Defense, Science, Mathematics, and Research for Transformation (SMART) scholarship. The scholarship includes full tuition, a job after graduation, and sponsored research. Read more about his journey and CoMFRE research here:

<https://news.engineering.iastate.edu/2021/09/28/comfre-graduate-student-earns-prestigious-dod-smart-scholarship/>

PPE innovation for healthcare workers is awarded \$1.8 million by CDC

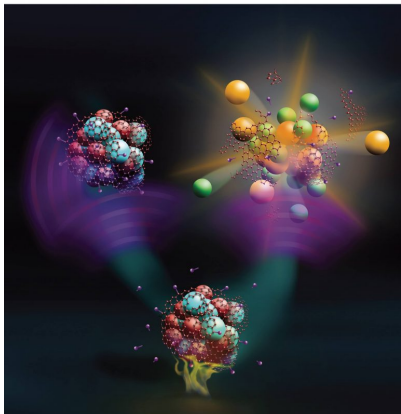
The AESHM Department's **Guowen Song**, who is also a CoMFRE faculty affiliate, is part of a team at Iowa State that has teamed up with UC Davis and the University of Cincinnati to develop personal protective equipment for healthcare workers. The project titled "Performance Improvement of Personal Protective Equipment (PPE) for Healthcare Workers" has been greenlit by the federal CDC NIOSH Occupational Safety and Health Research (R01) program, and has an awarded budget of \$1.8 million. The overall purpose of the grant is to improve PPE used in healthcare settings for infection control by incorporating functional textile materials and a new design for both gowns and respirators. Over the next several years, Dr. Song and his team are sure to make a difference in the world's PPE strategies.

<https://aeshm.hs.iastate.edu/current-students/facilities/laboratories-for-functional-textiles-and-protective-clothing/>

Cyclone Engineers' Research appears on the cover of ASC Applied Materials & Interfaces

The article includes authors and contributors Stuart Barkley, engineer with NSWC Crane Division ('21 Ph.D. mech engr); Adam Lawrence, graduate student in mechanical engineering; Murtaza Zohair, graduate student in mechanical engineering; Olivia Smithhisler, mechanical engineer with Honeywell; Cary Pint, Charles Schafer (Battelle) Chair in Engineering, associate professor of mechanical engineering; **James Michael**, assistant professor of mechanical engineering and Center for Multiphase Flow Research and Education affiliate; and **Travis Sippel**, associate professor of mechanical engineering and CoMFRE affiliate.

<https://news.engineering.iastate.edu/2021/09/01/smart-electromagnetic-thermite-research-on-cover-of-asc-applied-materials-and-interfaces/>



Upcoming CoMFRE Seminars

Seminar Date: Nov. 11, 2021



Joshua Heyne

Associate Professor, Mechanical and Aerospace Engineering, University of Dayton

Over the last five years, Professor Heyne has focused on aligning efforts and delivering objective criteria to help streamline the approval process of alternative jet fuels as part of the National Jet Fuels Combustion Program's (NJFCP) 40 institutions and 150 members. Outside of the NJFCP's integration and coordination role, Professor Heyne works on surrogates, high-performance fuel (HPF) formulation, combustion kinetics, well-stirred reactor development, forced ignition, and biomass stove combustion. The long-term aim of all of this work is to marshal greater environmental and national security.

Recent Degrees Granted to Students Working on Multiphase Projects

- Harshil Shah, Ph.D. Degree, "GPU-accelerated geometric algorithms for computational modeling and simulation," Advisor: **Adarsh Krishnamurthy**.
- Makrand A. Khanwale, Ph.D. Degree, "Energy stable and conservative numerical schemes for simulating two-phase flows using Cahn-Hilliard Navier Stokes equations using finite elements on adaptive octree meshes," Advisor: **Baskar Ganapathysubramanian**.

Faculty Honors and Awards

Patent Recipients: **Travis Sippel**, associate professor of mechanical engineering, and **James Michael**, assistant professor of mechanical engineering, *Microwave Flame Enhancement of Energetic Material Combustion*.

Student Honors and Awards

Harshil Shah, graduate student of **Adarsh Krishnamurthy**, won the best paper award at the CAD'21 conference in July.

<https://www.cad-conference.net/archive.html>

“GPU-Accelerated Post-Processing and Animated Volume Rendering of Isogeometric Analysis Results,” H. Shah, X. Huang, O. Bingol, M. Rajanna and **A. Krishnamurthy**, *Computer-Aided Design and Applications*, 19(a), 2022, bbb-ccc.

Recently Funded Research Awards

Feel free to contact the PI directly if you have any questions on the projects below.

- “LEAP-HI: AI-Optimized 3D Printing of Super-Soft Materials for Personalized Sensing;” **Baskar Ganapathysubramanian**, **Adarsh Krishnamurthy** and Soumik Sarkar; Funding Agency: NSF; New Funding Amount: \$2,000,000
 - “Controlling Spray Formation and Dispersion,” **Ted Heindel**, Funding Agency: Cornell University (flow through from ONR); New Funding Amount: \$75,000.
 - “Multiscale Mechanics of Composite Hydrogels Exposed to Shock Waves;” **Jaime Juarez** and Sarah Bentil; Funding Agency: NSF; New Funding Amount: \$548,815
-

Recent Journal Publications

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

- Barkley, S. J., A.R. Lawrence, M. Zohair, O.L. Smithisler, C.L. Pint, **J.B. Michael**, **T.R. Sippel**, "Smart electromagnetic thermites: GO/rGO nanoscale thermite composites with thermally switchable microwave ignitability," *ACS Applied Materials Interfaces*, vol. 13, August 2021. ([article featured on the cover of August issue](#)). [PDF](#)
- **Kingston, T.A.**, B.D. Olson, J.A. Weibel, and S.V. Garimella, “Transient flow boiling and maldistribution characteristics in heated parallel channels induced by flow regime oscillations,” *IEEE Transactions on Components, Packaging and Manufacturing Technology*, 2021. <https://ieeexplore.ieee.org/document/9517310>.

- LoCurto, A. C., M. A. Welch, **T. R. Sippel**, and **J. B. Michael**, "High-speed visible supercontinuum laser absorption spectroscopy of metal oxides," *Optics Letters*, 46, 3288-3291 (2021).
<https://www.osapublishing.org/ol/abstract.cfm?uri=ol-46-13-3288>
- Mukherjee, S., J. K. Streit, E. Gann, K. Saurabh, D. F. Sunday, **A. Krishnamurthy**, **B. Ganapathysubramanian**, L. J. Richter, R. A. Vaia, D. M. DeLongchamp, "Polarized X-ray scattering measures molecular orientation in polymer-grafted nanoparticles," *Nature Communications*, 12(1):1-10. <https://www.nature.com/articles/s41467-021-25176-4>
- Shabaniverki, S. and **J. J. Juárez**, "Directed assembly of particles for additive manufacturing of particle-polymer composites," *Micromachines* 12, no. 8: 935, 2021. <https://doi.org/10.3390/mi12080935>

Recent Conference Publications

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

- Balu, A., J. Khristy, M. R. Rajanna, **A. Krishnamurthy**, **M. Hsu**, "Immersogeometric analysis of flow over point cloud representations of objects," *US National Congress on Computational Mechanics*, Page 8, 2021.
- Belekar, V.V., Murphy, E., Sinha, K., Ho, R., Ketterhagen, W.R., Nere, N.K., **Heindel, T.J.**, and **Subramaniam, S.**, "The next evolution of multidisciplinary collaborations between industry and academia," *AICHE Particle Technology Forum Newsletter*, Vol. 26, No. 2, Summer 2021.
- Burtnett, T.J., Morgan, T.B., Dahlstrom, T.C., Aliseda, A., and **Heindel, T.J.**, "A pressurized tank for high flow rate atomization studies," *ICLASS – 15th International Conference on Liquid Atomization and Spray Systems*, Virtual, August 29 - September 2, 2021, Submission ID: 350.
- Jignasu, A., S. Ghadai, **A. Krishnamurthy**, "Direct fused deposition modeling (FDM) additive manufacturing of voxelized CAD models," *US National Congress on Computational Mechanics*," Page 443, 2021.
- Khara, B., A. Balu, A. Joshi, **A. Krishnamurthy**, S. Sarkar, C. Hegde, **B. Ganapathysubramanian**, "Field solutions of parametric PDEs," *US National Congress on Computational Mechanics*, Page 465, 2021.
- Pillers, R.A., and **Heindel, T.J.**, "Stereographic backlit imaging and bubble identification from a plunging jet with floor interactions," *ASME Fluids Engineering Division Summer Meeting*, Virtual, August 10-12, 2021, Paper Number: FEDSM2021-65313.
- Rade, J., E. Herron, A. Balu, S. Sarkar, **A. Krishnamurthy**, "Physics aware machine learning for structural topology optimization," *US National Congress on Computational Mechanics*, Page 861, 2021.
- Saraeian, M., A. Jafari, R. Braun, M. Hsu, **A. Krishnamurthy**, "Coupled left ventricular and atrial FSI simulations with bioprosthetic valves," *US National Congress on Computational Mechanics*, Page 932, 2021.
- Saurabh, K., B. Gao, M. Ishii, M. Fernando, M. Khanwale, B. Khara, S. Menon, **M. Hsu**, **A. Krishnamurthy**, H. Sundar, **B. Ganapathysubramanian**, "Industrial scale simulations using immersogeometric analysis on Octree meshes," *US National Congress on Computational Mechanics*, Page 899, 2021.
- Shah, H., O. R. Bingol, E. Johnson, M. Rajanna, **M. Hsu**, **A. Krishnamurthy**, "Modeling and isogeometric analysis of thin layered

- structures using volumetric NURBS,” *US National Congress on Computational Mechanics*, Page 839, 2021.
- Tan, K., B. Gao, C. Yang, E. Johnson, **M. Hsu, A. Krishnamurthy, A. Passalacqua, B. Ganapathysubramanian**, “An immersogeometric approach for transmission risk assessment in classrooms,” *US National Congress on Computational Mechanics*, Page 894, 2021.
 - Vu, V., Machicoane, N., Li, D., Morgan, T.B., **Heindel, T.J.**, Aliseda, A., and Desjardins, O., “Detailed validation of simulations of air-blast atomization against experimental shadowgraphs and radiographs,” *ICLASS – 15th International Conference on Liquid Atomization and Spray Systems*, Virtual, August 29 - September 2, 2021, Submission ID: 281.
 - Yang, C., K. Saurabh, H. Sundar, **A. Krishnamurthy, B. Ganapathysubramanian**, “Massively parallel implementation of the finite cell method on incomplete octrees,” *US National Congress on Computational Mechanics*, Page 785, 2021.

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