

Mehdi Vahab

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Research Faculty, Department of Mechanical Engineering, FAMU-FSU College of Engineering

Education and Post-Degree Training

- 2014–16 Post Doctoral Research Associate in Computational Science & Engineering
Department of Mathematics, Florida State University, Tallahassee, FL
Mentors: M. Yousuff Hussaini and Mark Sussman
- 2008–14 PhD, University of California, Davis, CA
Major: Applied Science, Computational Science and Engineering
Supervisor: Greg Miller
- 2006–08 MSc, Chalmers University of Technology, Goteborg, Sweden
Major: Applied Physics, Complex Adaptive Systems
Supervisor: Bernhard Mehlig
- 2001–05 BSc, KN Toosi University of Technology, Tehran, Iran
Major: Electrical Engineering and Control Systems
Supervisor: Alireza Fatehi

Work Experience

- 2017– Research Faculty, Department of Mechanical Engineering, FAMU-FSU College of Engineering
- 2016–17 Visiting Professor, Department of Mathematics, Florida A&M University
- 2014–16 Post Doctoral Research Associate, Department of Mathematics, Florida State University
- 2008–14 Teaching/Research Assistant, University of California, Davis
- 2005–06 System Developer, Advance Control System Lab. KN Toosi University
- 2003–05 Control System Developer, Ijad Niroo

Teaching Experience

- 2017-19 Numerical Methods for Engineers, Instructor, FAMU-FSU College of Engineering
- 2016-17 College Algebra, Instructor, Florida A&M University
- 2016-17 Statistics, Instructor, Florida A&M University
- 2014 Computational Methods for Chemical Engineers, Lab Instructor, UC Davis
- 2013-14 Introduction to Engineering Methods, The Design of Coffee, Lab Instructor, UC Davis
- 2013 Mathematical Methods in Biochemical and Chemical Engineering, Teaching Assistant, UC Davis
- 2012 The Science Behind the Technology in Our Lives, Teaching Assistant, UC Davis
- 2009-10 Numerical Solution of Engineering and Scientific Problems, Teaching Assistant, UC Davis
- 2005 Logical/PLC Programming, Instructor, Novin Andishe Alborz, Tehran, Iran
- 2004 C programming, Teaching Assistant, KNTU, Tehran, Iran

Research Interests

Multimaterial systems	Phase change dynamics	Systems of conservation laws
Heat transfer	Dynamical systems	Chaotic systems analysis

Reports and Publications

- M. Vahab, K. Shoele, M.Y. Hussaini and M. Sussman, **A continuous moment-of-fluid method for modeling multimaterial systems**, (2019). in prep.
- M. Vahab, M. Sussman, M.Y. Hussaini, **An adaptive moment-of-fluid method for simulating solidification process in multimaterial systems**, (2019). in prep.
- M. Vahab, K. Shoele, **Active vortex generator to improve heat transfer in heat exchangers**, Under review at United States Patent and Trademark Office (2019).

- M. Vahab, K. Shoele, M. Sussman, **Interaction of an Oscillating Flexible Plate and Nucleate Pool Boiling Vapor Bubble: Fluid-Structure Interaction in a Multimaterial Multiphase System**, *48th AIAA Fluid Dynamics Conference*, AIAA 2018-3718, (2018), (Link)
- Y. Lian, D. Liao, H. Qiu, M. Sussman, M. Vahab, Y. Hussaini, **Experimental and Numerical Investigation of Icing Process of a Liquid Droplet**, *9th AIAA Atmospheric and Space Environments Conference AIAA AVIATION Forum*, AIAA 2017-4481, (2017), (Link)
- M. Vahab, C. Pei, M. Y. Hussaini, M Sussman and Y. Lian, **An adaptive coupled level set and moment-of-fluid method for simulating droplet impact and solidification on solid surfaces with application to aircraft icing**, *54th AIAA Aerospace Sciences Meeting*, p. 1340, (2016) (Link)
- M. Vahab, G. Miller, **A front-tracking shock-capturing method for two gases**, *Communication in Applied Mathematics and Computational Science*, 11-1, (2015): 1-35, (Link)
- M. Vahab, **A front-tracking shock-capturing method for two fluids**, *PhD Dissertation*, UC Davis, (2014) (Link)
- M. Vahab, Design of a high-order front tracking method in 2D, *Master Thesis*, UC Davis, (2010) (Link)
- M. Vahab, **Relative velocities of particles suspended in stochastic Kolmogorov turbulence**, *Master Thesis*, Chalmers University, (2008) (Link)

Presentations

- **Interaction of an oscillating flexible plate and nucleate pool boiling vapor bubble: fluid-structure interaction in a multimaterial multiphase system**, *48th AIAA Fluid Dynamics Conference, AIAA AVIATION Forum*, 2018
- **A coupled level-set and moment-of-fluid method for multiphase systems with solidification**, *International Conference on Numerical Methods for Multi-Material Fluid Flows*, 2017
- **An adaptive coupled level set and moment-of-fluid method for simulating the solidification process in multimaterial systems**, *SIAM Conference on Computational Science and Engineering*, 2017
- **An adaptive coupled level set and moment-of-fluid method for simulating the solidification process in multimaterial systems**, *School of Mathematics, Georgia Institute of Technology*, 2016
- **An adaptive coupled level set and moment-of-fluid method for simulating droplet impact and solidification on solid surfaces with application to aircraft icing**, *AIAA 54th Aerospace Sciences Meeting*, 2016
- **An adaptive coupled level set and moment-of-fluid method for simulating droplet impact and solidification on solid surfaces with application to aircraft icing**, *Florida State University, Department of Scientific Computing*, 2015
- **Numerical methods for fractional order systems**, *39th SIAM Southeastern Atlantic Section Conference SIAM-SEAS*, 2015
- **High-order interface tracking methods for compressible and incompressible two-phase flow**, *SIAM Conference on Computational Science and Engineering*, 2013
- **A front-tracking method for moving fronts and hyperbolic conservation laws**, *SIAM Annual Meeting*, 2012
- **A front-tracking method for systems of hyperbolic conservation laws**, *Davis SIAM Student Research Conference*, 2012

Selected Projects

- Fluid structure interaction in multiphase/multimaterial systems

- Applied a force feedback method to implement FSI
- Improved the current techniques to have variable density ratio along the fluid-structure interface
- Performed qualitative and quantitative tests for method verification
- Utilize method to study the effects of active vortex generation on nucleate pool boiling
- Implemented in FORTRAN, C++ using BoxLib

- **Continuous moment-of-fluid method for multimaterial systems**
 - Formulated the continuous moment-of-fluid for multimaterial systems
 - Applied CMOF approach for the systems where the surface tension forces are dominant
 - Revised the algorithm to resolve accurate contact angle on solid surfaces
 - Compared with MOF and CLSVOF method for analytical and experimental solutions
 - Implemented in FORTRAN, C++ using BoxLib
- **Modeling and simulation of droplet impact and solidification on solid surfaces**
 - Considered the impact and solidification of supercooled water droplets
 - Applied a coupled moment of fluid and level set method to capture the sharp freezing front
 - Employed an adaptive mesh refinement approach
 - Comparison made with analytical and experimental results
 - Implemented in FORTRAN, C++ using BoxLib
- **High order method for free boundary two phase flow systems**
 - Designed a hybrid method for hyperbolic systems of conservation laws
 - Adapted a finite volume method on Cartesian grid for irregular moving geometries
 - Devised a high order level set method for performing geometrical calculation
 - Tested for front tracking and shock capturing in gas dynamics
 - Successfully applied for study of Richtmyer–Meshkov instability
 - Implemented in C++ using Chombo
- **Stochastic modeling of Kolmogorov turbulence and suspended particles**
 - Implemented a multiscale stochastic model of turbulence with energy spectrum characterization
 - Developed spatial and temporal correlation verification methods
 - Created verification methods based on analysis of topological properties of the velocity field
 - Performed simulation and analysis for suspended particles coalescence
 - Implemented in C
- **Traffic modeling**
 - Developed an agent based modeling for driver/road interaction
 - Performed phase space verification of traffic flow based on empirical data
 - Facilitated an interface to create user defined maps
 - Implemented in Java

Professional Skills

- Programming Languages: C++, C, FORTRAN, MATLAB, Assembly, Java
- Modeling environments: Simulink, StateFlow
- Computational libraries: LAPACK, BLAS, Chombo, BoxLib
- System administration: Linux, Windows

Synergistic Activities

- Member of Society for Industrial and Applied Mathematics (SIAM), and American Institute of Aeronautics and Astronautics (AIAA)
- Organized minisymposia for SIAM meetings
- Reviewer for Journal of Computational Physics, International Journal of Multiphase Flow, International Journal of Heat and Fluid Flow, and Journal of Applied Polymer Science
- Prepared and submitted proposal to NSF, DoD MURI, and SERDP