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EDUCATION

Sc. D. Massachusetts Institute of Technology, Ocean Engineering.
Navier-Stokes Simulation of Steep Breaking Water Waves with a Coupled Air-Water Interface. Prof. Dick K.-P. Yue (chair), Prof. Michael S. Triantafyllou, Prof. Nicholas C. Makris, Dr. Douglas G. Dommermuth

B. S. University of Cincinnati, Aerospace Engineering.
Focus in compressible fluid mechanics and computational fluid dynamics.

CURRENT RESEARCH AREAS

Multiphase turbulent flow and transport phenomena; Turbulent transport of active and passive scalar fluxes; Turbulence and breaking wave dissipation and flux modeling; Turbulence closure modeling; Machine learning assistance to closure modeling; Distributed small-scale computing techniques; Coupled air-water interface and boundary layer dynamics; Data visualization; Computational fluid dynamics.

RESEARCH EXPERIENCE

Research Engineer, (2005 – present)
Department of Mechanical Engineering, M.I.T.
Applied theoretical, analytical and computational fluid dynamics to conduct extensive research experience in:

Incompressible highly variable density turbulence, entrainment in violent interfacial flows, multiphase turbulence modeling, viscous free-surface flows, waves and wave breaking dynamics, coupled air-sea interface dynamics, turbulence, vortical dynamics, spray droplet modeling, hydrodynamics, radiation transfer in a dynamic ocean, smoothed particle hydrodynamics, phase-resolved large-scale ocean simulations, water impact cavity dynamics and high-performance computing techniques.

GRANTS

Current Funding, Co-Principal Investigator

Structures, Mechanisms & Statistics of Air-Entraining Free-Surface Turbulent Flows, *Office of Naval Research,* $495K, 2017-2019.

Past Recent Funding, Co-Principal Investigator

Mechanistic Study and Modeling of Air Entrainment and Bubbly Flow in Ship Wakes, *Office of Naval Research,* $543K, 2013-2016.

Prediction of Two-Phase High-Viscosity Gas-Liquid Flows in Three-Dimensional Horizontal and Inclined Pipes, $420K, *Chevron*, 2013-2016.

RECENT PUBLICATIONS

Works Under Review

Yu, X., Hendrickson, K., & Yue, D. K.-P. Scale dependence of entrainment bubble size distribution in free-surface turbulence. *Submitted to Journal of Fluid Mechanics.*

Hendrickson, K., Weymouth, G. & Yue, D. K.-P. Informed Component Label Algorithm for Identifying Connected Regions of Eulerian Data. *Submitted to Computers & Fluids.*

International Refereed Journals

Yu, X., Hendrickson, K., Campbell, B., Yue, D. K.-P. Numerical Investigation of Shear-Flow Free-surface Turbulence and Air Entrainment at Large Froude and Weber Numbers. *To appear Journal of Fluid Mechanics.*

Hendrickson, K., Weymouth, G., Yu, X. & Yue, D. K.-P. (2019) Three-dimensional dry transom stern wakes. Part 1: Flow structure and large-scale air entrainment. *Journal of Fluid Mechanics*, 875, 854-883.

Hendrickson, K. & Yue, D. K.-P. (2019) Three-dimensional dry transom stern wakes. Part 2: Analysis and modeling of incompressible highly-variable density turbulence. *Journal of Fluid Mechanics*, 875, 884-913.

Hendrickson, K. & Yue, D. K.-P. (2019) Structures and mechanisms of air-entraining quasi-steady breaking ship waves. *Journal of Ship Research,* 63(2), 67-77.

Miao, S., Hendrickson, K. & Liu, Y. (2019) Slug generation processes in co-current turbulent-gas/laminar-liquid flows in horizontal channels. *Journal of Fluid Mechanics,* 860, 224-257.

Miao, S., Hendrickson, K., Liu, Y. (2017). Computation of three-dimensional multiphase flow dynamics by Fully-Coupled Immersed Flow (FCIF) Solver. *Journal of Computational Physics*, 350, 97-116.

Campbell, B. K., Hendrickson, K., Liu, Y. (2016). Nonlinear coupling of interfacial instabilities with resonant wave interactions in horizontal two-fluid plane Couette/Poiseuille flows: Numerical and Physical Observations. *Journal of Fluid Mechanics,* 809, 438-479.

Hendrickson, K., Weymouth, G., Banerjee, S., & Yue, D.K.-P. (2013). Air Entrainment and Multiphase Turbulence in the Bubbly Wake of a Transom Stern. *International Shipbuilding Progress*, 60(1), 375-401.

Kiara, A., Hendrickson, K., & Yue, D. K.-P. (2013). SPH for incompressible free-surface flows. Part I: Error analysis of the basic assumptions. *Computers & Fluids*, 86, 611-624.

Kiara, A., Hendrickson, K., & Yue, D. K.-P. (2013). SPH for incompressible free-surface flows. Part II: Performance of a modified SPH method. *Computers & Fluids*, 86, 510-536.

Recent International Symposia

Hendrickson, K. & Yue, D. K.-P. (2018). Structures and Mechanisms of Air-Entraining Quasi-Steady Breaking Ship Waves. *Proceedings of the 32nd Symposium on Naval Hydrodynamics,* Hamburg, Germany. Selected for publication in Journal of Ship Research.

Hendrickson, K., Banerjee, S. & Yue, D. K.-P. (2016). Analysis of the Incompressible Highly Variable Density Turbulent Flow in the Near Wake of a Surface Ship. *Proceedings of the 31st Symposium on Naval Hydrodynamics,* Monterey, CA.

Subramani, H., Kiara, A., Campbell, B., Hendrickson, K., & Liu, Y. (2013). Multi-Dimensional Modeling of Two-Phase Flows in Channels and Pipelines. *Proceedings of the 2013 Offshore Technology Conference*, Houston, TX.

RECENT CONFERENCE PRESENTATIONS

Hendrickson, K. & Yue, D. K.-P. (2018) Scale effects for air entrainment in quasi-steady breaking waves. *71st Annual Meeting of the American Physical Society Division of Fluid Dynamics*, Atlanta, GA.

Hendrickson, K. & Yue, D. K.-P. (2017) Simulations of quasi-steady breaking waves: flow structure. *70th Annual Meeting of the American Physical Society Division of Fluid Dynamics,* Denver, CO.

Hendrickson, K. & Yue, D. K.-P. (2016) Turbulent mass flux closure modeling for variable density turbulence in the wake of an air-entraining transom stern. *69th Annual Meeting of the American Physical Society Division of Fluid Dynamics,* Portland, OR.

Hendrickson, K., Banerjee, S. & Yue, D. K.-P. (2015) Modeling variable density turbulence in the wake of an air-entraining transom stern. *68th Annual Meeting of the American Physical Society Division of Fluid Dynamics,* Boston, MA.

Hendrickson, K., Banerjee, S. & Yue, D. K.-P. (2014) Multiphase turbulence modeling of the flow in the wake of a transom stern. *67th Annual Meeting of the American Physical Society Division of Fluid Dynamics,* San Francisco, CA.

Hendrickson, K., Weymouth, G., & Yue, D. K.-P. (2013) Analysis of the two-phase flow in the wake of a transom stern. *66th Annual Meeting of the American Physical Society Division of Fluid Dynamics,* Pittsburgh, PA.

TEACHING & MENTORING EXPERIENCE

Ph. D. Thesis Committee Membership, M.I.T. (2010 – present)
Served as committee member for multiple Ph. D. theses with topics in the field of multiphase turbulence simulations, multiphase turbulence modeling, coupled gas-liquid interface instabilities, nonlinear interface instabilities, and theoretical analysis of interfacial instabilities and novel simulation techniques.

Graduate Student Mentoring, M.I.T.
Mentored graduate students in conjunction with their thesis advisor. Involved meeting regularly with students to assess their research progress, answer technical and scientific questions, and advise in future directions of their research.

Undergraduate Student Supervision, M.I.T.
Direct supervision of undergraduate students through Undergraduate Research Opportunity Program (UROP) on projects specific to cavity interface and spray dynamics.

Substitute Lecturer/Teaching Assistant, M.I.T.
Marine Hydrodynamics, Hydrodynamics for Ocean Engineers
Substitute lecturer for graduate and undergraduate hydrodynamics courses. Responsible for planning and teaching recitations, designed and supervised laboratory experiments in marine fluid mechanics, developed and assigned homework assignments, drafted exams.

Freshman Advisor, M.I.T.
Advise freshman academically on course selection and major choice. Develop and build knowledge and relationship with student so student can share thoughts, concerns, interests and future goals.

TEACHING CAPABILITIES

Capable of teaching core engineering subjects at the undergraduate level including: fluid dynamics, hydrodynamics, heat and mass transfer, turbulence, engineering mathematics, computational methods, and numerical analysis. Also capable of teaching upper level subjects in fluid dynamics, turbulence and computational methods.

PROFESSIONAL AFFILIATIONS

American Geophysical Union
American Physical Society

MANAGEMENT EXPERIENCE

Co-Principal Investigator, 2008-present
Received Departmental permission to submit grant proposals as Co-Principal Investigator on numerous grants. Responsibilities include: direct supervision of graduate students, overall project and resource management, prepare and deliver communication to sponsoring agency, and general project direction.

Vortical Flow Research Lab Manager & System Administrator, 2005-2009
Responsible for the design, development and maintenance of advanced computational facility which includes a dozen powerful computer workstations, two high performance computing clusters, and graphics visualization capabilities.

iMarine Project Developer & Manager, 2005-2007
Guided and coordinated the technical development of an interactive learning platform iMarine. Position involved managing and interacting with software engineers, web designers, laboratory experiment designers, educators and students to meet preliminary test platform deadlines.

EDITORAL SERVICE

Invited reviewer for Physics of Fluids, Journal of Computational Physics, Journal of Fluid Structure Interactions, Journal of Ocean Engineering and Marine Energy. Invited discussant for Symposium on Naval Hydrodynamics, 2000 - present

INSTITUTE & DEPARMENTAL SERVICE

Freshman Academic Advisor, Mechanical Engineering Website Development Committee Member, Center for Ocean Engineering Website Development Committee Member.

RECENT PROFESSIONAL EXPERIENCE

Software Development & Support, (2011 – present)
WAMIT Inc.
Development of graphical user interface and remote licensing capabilities for WAMIT. Responsible for user support.

WAMIT is a panel method for the analysis of wave interactions with offshore platforms, structures and vessels.