Yulin Pan, Ph.D.

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Academic Appointment • Postdoctoral Associate, Massachusetts Institute of Technology 2016 - present Advisor: Prof. Pierre F.J. Lermusiaux Education • Massachusetts Institute of Technology Cambridge, MA Ph.D. in Mechanical and Oceanographic Engineering, with minor in Mathematics. 2009 - 2016– Advisor: Prof. Dick K.P. Yue - Thesis: Understanding of weak turbulence of capillary waves • University of Texas at Austin Austin, TX Master of Science in Civil Engineering. 2007 - 2009– Advisor: Prof. Spyros A. Kinnas - Thesis: A viscous/inviscid interactive approach and its application to hydrofoils and propellers with nonzero trailing edge thickness • Huazhong University of Science and Technology Wuhan, China 2003 - 2007 Bachelor of Science in Naval Architecture and Ocean Engineering.

Research Focus

• Theoretical and Computational Hydrodynamics; Ocean and Marine Engineering; Surface and Internal Waves; Nonlinear Wave Mechanics; Wave Turbulence Theory; Ocean Renewable Energy; Fluid-Structure Interaction; Propeller and Biomimetic Foil Propulsion; Hydrodynamic Lubrication

Research Experience

- MSEAS (Multidisciplinary Simulation, Estimation, Assimilation Systems) Group, MIT Postdoctoral Associate 2016 - present
 - Prediction of rogue wave based on deep learning.
 - * Construct a database of rogue wave generation on ocean surface using nonlinear simulation.
 - * Develop a deep learning model, trained by the database, to predict the occurrence of rogue wave.

- Interaction of internal tide with the inhomogeneous ocean background.

- * Developed theory to describe the modal evolution of internal tide in an inhomogeneous background with varying mean flow, topography and density.
- * Obtained analytical solutions for the modulation of internal tide by mean flow using WKB analysis.
- * Verified the theoretical prediction by simulation of Primitive Equations using finite volume method.

• Vortical Flow Research Lab, MIT

Research Assistant

- Understanding of weak turbulence of capillary waves.

- * Obtained a correction to the weak turbulence theory on the analytical value of Kolmogorov constant.
- * Developed numerical simulations for capillary wave field using high-order spectral method.
- * Established a framework to evaluate the properties of a stationary spectrum in numerical simulations.
- * Developed theory to describe the discrete turbulence in a finite domain, which is corroborated by numerical simulations.

- Analysis and simulation of long-short water wave interaction

* Proved the theoretical convergence of the high-order expansion series of long-short wave interaction using mathematical induction, which resolves a historical debate on the problem.

2009 - 2016

* Developed a mapping scheme to circumvent the numerical divergence in high-order spectral simulation.

- Panel method for the performance prediction of flapping foils with leading-edge separation.

- * Developed a panel method for the simulation of flow around flapping foils with vortices shed from both leading and trailing edges, which obtained excellent agreement with measurements.
- * Developed an optimization for flapping motions to maximize the performance of flapping foils.

• ExxonMobil Upstream Research Company

Summer Intern

- Application of wavelet analysis on wave impact signal.
 - * Developed a framework for the wavelet analysis on the time-series of wave impact pressure signals.
 - * Uncovered several mechanisms of the impact from the signals.
- Computational Hydrodynamics Lab, University of Texas at Austin Research Assistant
 - A viscous/inviscid interactive panel method and its application to hydrofoils and propellers with non-zero trailing edge thickness.
 - * Developed an iterative scheme, coupling with panel method, to predict the performance of hydrofoils and propellers with non-zero trailing edge thickness.
 - $\ast\,$ Validated the prediction results against experimental measurements.

Teaching Experiences

- Marine Hydrodynamics (2.20, graduate), MIT Teaching Assistant (twice)
 - Delivered weekly lectures of recitation for a class of 30.
 - Designed and graded homework and exams.
 - Designed and lead wave tank experiments.
- Introductory Ocean Engineering (CE358, undergraduate), UT-Austin Teaching Assistant

- Instructed students in the use of CFD software.

Journal Publications

- Pan, Y., Haley, P.J. and Lermusiaux, P.F.J. 2017, Interaction of internal tide with an inhomogeneous and rotational ocean background, *Journal of Fluid Mechanics*, sub-judice.
- Wang, Y., **Pan**, **Y.**, Kamp, C., Srinivasan, A. and Gong, J. 2017, Analytical Solution of One-Dimensional Model of Asymmetric Particulate Filter with Soot and Ash Deposits, *Chemical Engineering Science*, sub-judice.
- Pan, Y., Liu, Y. and Yue, D.K.P. 2017, On the high-order perturbation expansion for the study of long-short wave interactions, *Journal of Fluid Mechanics*, in press.
- Pan, Y. and Yue, D.K.P. 2017, Understanding discrete capillary wave turbulence using quasi-resonant kinetic equation, *Journal of Fluid Mechanics*, 816, R1, 1-11.
- Pan, Y. and Yue, D.K.P. 2015, Decaying capillary wave turbulence under broad-scale dissipation, *Journal of Fluid Mechanics*, 780, R1, 1-11.
- Pan, Y. and Yue, D.K.P. 2014, Direct numerical investigation of turbulence of capillary waves, *Physical Review Letters*, 113, 094501.
- Pan, Y., Dong, X., Zhu, Q. and Yue, D.K.P. 2012, Boundary-element method for the prediction of performance of flapping foils with leading-edge separation, *Journal of Fluid Mechanics*, 698, 446-467.
- Pan, Y. and Kinnas, S.A. 2011, A viscous/inviscid interactive approach for the prediction of performance of hydrofoils and propellers with non-zero trailing edge thickness, *Journal of Ship Research*, 55, 1, 45-63.

06/2015 - 09/2015

2007 - 2009

Fall 2010, Fall 2011

Fall 2008

Selected Conference Papers/Presentations

- Pan, Y. and Yue, D.K.P. 2015, Understanding capillary wave turbulence using discrete quasi-resonant kinetic equation, 68th Annual Meeting of the APS Division of Fluid Dynamics, Boston, MA.
- Pan, Y. and Kinnas, S.A. 2009, A Viscous/Inviscid Interactive Approach and its Application to Hydrofoils and Propellers with Non-Zero Trailing Edge Thickness, *First International Symposium on Marine Propulsors*, Trondheim, Norway.
- Pan, Y. and Kinnas, S.A. 2008, Modeling of flow around inclined shaft using Fluent, 29th Consortium on Cavitation of High Speed Propulsors, Austin, TX.

Extracurricular writing on popular science (Chinese)

- Pan, Y., 81次获提名, 诺奖界无冕之王搅动流体江湖风云(上) (Nominated 81 times, the uncrowned king of Nobel Prize disturbs the world of fluid mechanics), *The Intellectual*, September, 2016
- Pan, Y., 一波三折湍流沉寂,知难而上林氏破迷(下) (Following a series of frustrations from the predecessors, Lin solves the mystery of turbulence problem), *The Intellectual*, September, 2016
- Pan, Y., 流体江湖风云录-东邪柯尔莫哥洛夫(一) (The legend of fluid mechanics the "Eastern Heretical" Kolomogrov, I), *The Intellectual*, November, 2016
- Pan, Y., 湍流界的九阴真经: K41理论 | 流体江湖风云录-柯老邪篇(二) (Supremacy in turbulence: K41 theory | the legend of fluid mechanics Komogorov, II), *The Intellectual*, December, 2016
- Pan, Y., 席卷六合, 美玉微瑕 | 流体江湖风云录-柯老邪篇(三) (Gaining a worldwide reputation, an imperfection is found in the theory | the legend of fluid mechanics -Komogorov, III), *The Intellectual*, December, 2016
- Pan, Y., 衣钵得传, 后继有人 | 流体江湖风云录-柯老邪篇(四) (Mastership inherited by a successor | the legend of fluid mechanics Komogorov, IV), *The Intellectual*, June, 2017

Student supervision

- Wentao Xu, Ph.D. candidate, Shanghai Jiao tong University (co-supervision with Prof. Ye Li) Research topic: Experimental study on water wave turbulence.
- Rui Pan, Bachelor in Physics, summer intern at Academy for Advanced Research and Development Research topic: Theory of gravity wave turbulence.

Proposal writing

- Near-Inertial Wave Interactions: Background Shear, Waves, and Energy Transfer (with Prof. Pierre Lermusiaux), submitted to the Office of Naval Research (ONR).
- Computation of Nonlinear Water Waves on GPU (with Prof. Dick Yue), submitted to the ONR...

Awards

- Fellowship in Ocean Sciences and Engineering, MIT, 2009.
- Tsuneishi Scholarship (top 2%), Huazhong University of Science and Technology, 2006.
- Excellent Student Scholarship (top 2%), Huazhong University of Science and Technology, 2003 2007.

Reviewer for Journals

- Physical Review Letters
- Journal of Fluid Mechanics
- Physics of Fluids
- PLOS ONE
- Applied Ocean Research
- Journal of Hydrodynamics
- Journal of Fluids Engineering