CURRICULUM VITAE

LIAN SHEN

Benjamin Mayhugh Associate Professor
Department of Mechanical Engineering and St. Anthony Falls Laboratory
University of Minnesota

Education

Degree	Institution	Date Degree Granted
B.S. Mechanics and Mechanical Engineering	University of Science and Technology of China	1993
Sc.D. Fluid Mechanics Advisor: Dick K.P. Yue	Massachusetts Institute of Technology	2001

Positions/Employment

University of Minnesota, Twin Cities
Associate Professor, Department of Mechanical Engineering 2012 – present
and Associate Director for Research, St. Anthony Falls Laboratory 2014 – present

Johns Hopkins University 2004 – 2012
Assistant Professor and Assistant Research Professor, Department of Civil Engineering and Center for Environmental and Applied Fluid Mechanics

Massachusetts Institute of Technology 2001 – 2003
Postdoctoral Associate and Research Engineer, Department of Ocean Engineering

Visiting Professorships or Visiting Scholar Positions

- Visiting Associate Professor at Johns Hopkins University; Department of Civil Engineering; November, 2012 – June 2015; focused on finishing collaborative study in fluid mechanics with former colleagues.
- Visiting Assistant Professor at Massachusetts Institute of Technology; Department of Mechanical Engineering; August, 2008; focused on collaborative study on water waves and radiative transfer.

Current Membership in Professional Organizations

- American Geophysical Union
- American Physical Society, Division of Fluid Dynamics
- American Society of Civil Engineers
- American Society of Mechanical Engineers
- Association of Environmental Engineering and Science Professors

HONORS AND AWARDS

- T. Francis Ogilvie Young Investigator Lectureship, 2009
- Office of Naval Research Young Investigator Award, 2006
- Martin A. Abkowitz Fellowship, 1998

RESEARCH

Research Interests

- Computational fluid dynamics
  - High-fidelity simulation of flows with wavy boundaries, including DNS and LES of turbulence on boundary-fitted grid and phase-resolved simulation of nonlinear water waves;
  - Multiphase flow simulation, including level-set and volume-of-fluid methods for free-surface flows and Lagrangian-Eulerian method for particle-laden flows;
  - Simulation of flows in complex geometries with advanced immersed boundary methods and fluid-structure interactions; and
  - Scientific computing and modeling, including high-performance parallel computing, data-intensive computing, multi-physics modeling, and data assimilation.
- Geophysical fluid flows
  - Environmental fluid mechanics, including transport of oil spills at sea and in lakes, and atmosphere-ocean transfer of greenhouse gases;
  - Atmospheric flows, with a focus on the turbulence atmospheric surface layers over land and oceans; and
  - Physical oceanography, with a focus on upper-ocean processes including air-sea interactions, wind-wave interactions, and wave-current interactions.
- Engineering fluid flows
  - Bubbly and cavitation flows;
  - Particle-laden flows; and
  - Heat and mass transfer.
- Multidisciplinary fluid-related research
  - Biological flows and biomimetics, e.g., fish swimming;
  - Renewable energy, including wind energy, wave energy, and marine hydrokinetic energy; and
  - EM/EO and radiative transfer, including electromagnetic propagation in atmosphere and electro-optical propagation in atmosphere and upper oceans.

Grants and Contracts

Summary:

2012 – present, at University of Minnesota: 18 grants. 4 completed, 10 currently active, and 4 incoming. 10 as PI, 8 as co-PI. From 10 different funding agencies. Approximately $16.5M in total, of which Lian Shen directs over $6M.

2004 – 2012, at Johns Hopkins University: 12 grants. 10 as PI, 2 as co-PI. From 3 different funding agencies. Approximately $9.7M in total, of which Lian Shen directed over $2M.

At the University of Minnesota:

Proposals recommended for funding:

1. *Investigator status:* Co-investigator
   Name of PI: Qing Wang (Naval Postgraduate School)
   Other co-investigator: Ronald Phillips (University of Central Florida)
   External agency: Department of Defense
   Project title and dates: Quantifying and understanding atmospheric turbulence affecting optical propagation, 2017 – 2022
   Amount: $2,997,051. Approximately 30% ($890,250) goes to Lian Shen.

2. *Investigator status:* Principal investigator
   Co-investigator: Douglas Dommermuth (Breaking Wave Analysis Consulting)
   External agency: Office of Naval Research
   Project title and dates: Improvement of wave-ocean-wind (WOW) codes and development of data assimilation, 2017 – 2020
   Amount: $573,287. Approximately 74% ($423,197) goes to Lian Shen.

3. *Investigator status:* Co-investigator
   Name of PI: Filippo Coletti (UMN AEM & SAFL)
   Other co-investigator: Jane Davidson (UMN ME)
   External agency: Environment and Natural Resources Trust Fund
   Project title and dates: Enabling extraction of solar thermal energy in Minnesota, 2017 – 2020
   Amount: $250,000 (direct cost). Approximately 30% (about $74,000) goes to Lian Shen.

4. *Investigator status:* Co-investigator
   Name of PI: Michele Guala (UMN CEGE & SAFL)
   Other co-investigators: Jeffrey Marr, Jessica Kozarek, Anvar Gilmanov (all UMN SAFL)
   Funding source: UMN Institute on the Environment
   Project title and dates: Developing a bank-protection, energy-converter system for straight and meandering rivers, 2017 – 2020
   Amount: $149,950 (direct cost). Allocation of budget unspecified in proposal.

Currently active projects:

5. *Investigator status:* Principal investigator
   External agency: National Science Foundation
   Project title and dates: Study of the fundamental dynamics of water wave effects on turbulence for environmental applications, 2016 – 2019
   Amount: $299,815. 100%.

6. *Investigator status:* Principal investigator
   External agency: National Science Foundation
   Project title and dates: Direct phase-resolved simulation of wind-waves, 2013 – 2017
   Amount: $195,248. 100%.

7. *Investigator status:* Principal investigator

External agency: Minnesota Sea Grant of National Oceanic and Atmospheric Administration
Project title and dates: Investigation of oil spills in aquatic environment subject to wind and wave influences, 2016 – 2019
Amount: $159,720. 100%.

8. *Investigator status:* Co-investigator
Name of PI: Qing Wang (Naval Postgraduate School)
Other co-investigators: Robert Burkholder (Ohio State University), Harindra Fernando (University of Notre Dame), Djamal Khelif (University of California, Irvine), Kipp Shearman (Oregon State University)
External agency: Office of Naval Research
Project title and dates: MURI: Coupled air sea processes and EM ducting research (CASPER), 2014 – 2019
Amount: $7,437,924. Approximately 12.7% ($947,377) goes to Lian Shen.

9. *Investigator status:* Principal investigator
External agency: Office of Naval Research
Project title and dates: Dynamic simulations of realistic upper-ocean flow processes to support measurement and data analysis, 2014 – 2017
Amount: $525,000. 100%.

10. *Investigator status:* Principal investigator
Co-investigator: Fotis Sotiropoulos (UMN SAFL and Stony Brook University)
External agency: Office of Naval Research
Project title and dates: Large-eddy simulation of coastal land-air-sea interactions, 2016 – 2018
Amount: $425,274. 100% (Fotis Sotiropoulos will make intellectual contributions but will not charge salary).

11. *Investigator status:* Principal investigator
External agency: National Oceanographic Partnership Program
Project title and dates: A multiscale nested modeling framework to simulate the interaction of surface gravity waves with nonlinear internal gravity waves, 2015 – 2018
Amount: $450,000. 100%.

12. *Investigator status:* Co-investigator
Name of PI: Christopher Hogan (UMN ME)
External agency: Donaldson Company, INC
Project title and dates: Permeability theories for depth loaded liquid filter media, 2016 – 2016
Amount: $41,319. Approximately 30% (about $12,400) goes to Lian Shen.

13. *Investigator status:* Co-investigator
Name of PI: William Drennan (University of Miami)
External agency: Gulf of Mexico Research Initiative
Project title and dates: Investigation of oil spill transport in a coupled wind-wave-current environment using simulation and laboratory studies, 2016 – 2018
Amount: $992,274. Approximately 40% ($399,909) goes to Lian Shen.

14. *Investigator status:* Principal investigator

Other co-investigators: Michele Guala (UMN CEGE & SAFL), Jiarong Hong (UMN ME & SAFL), Jeffrey Marr (UMN SAFL), Joseph Nichols (UMN AEM), Peter Seiler (UMN AEM & SAFL)
Funding source: University of Minnesota Renewable Development Fund
Project title and dates: Simulation, measurement, modeling, and control of wind plant power, 2016 – 2019
Amount: $717,360. Allocation of budget unspecified in proposal.

Completed projects:

15. *Investigator status:* Principal investigator
External agency: National Science Foundation
Project title and dates: Computation of marine atmospheric boundary layer and nonlinear ocean wavefield for energy for sustainability, 2013 – 2016
Amount: $177,809. 100%.

16. *Investigator status*: Principal investigator
External agency: Office of Naval Research
Project title and dates: Quantifying the dynamic ocean surface using underwater radiometric measurements, 2013 – 2015
Amount: $300,000. 100%.

17. *Investigator status*: Co-investigator
Name of PI: Fotis Sotiropoulos (UMN CEGE & SAFL)
Other co-investigator: Michele Guala (UMN CEGE & SAFL)
External agency: Department of Energy
Project title and dates: High-resolution computational algorithms for simulating offshore wind turbines and farms: model development and validation, 2011 – 2015
Amount: $780,000. Allocation of budget unspecified in proposal.

18. *Investigator status:* Co-investigator
Name of PI: Christopher Hogan (UMN ME)
External agency: Donaldson Company, INC
Project title and dates: Model development for particle deposition by sieving, 2015 – 2015
Amount: $33,000. Approximately 30% (about $11,000) went to Lian Shen.

Previously at the Johns Hopkins University:

1. *Investigator status:* Principal investigator
External agency: National Science Foundation
Project title and dates: Direct phase-resolved simulation of wind-waves, 2012 – 2013
Amount: $98,595. 100%.

2. *Investigator status:* Principal investigator
External agency: National Science Foundation
Project title and dates: Computation of marine atmospheric boundary layer and nonlinear ocean wavefield for energy for sustainability, 2011 – 2013
Amount: $105,365. 100%.

3. *Investigator status:* Principal investigator

External agency: Office of Naval Research
Project title and dates: Development and demonstration of environmental and ship motion forecasting system, 2011 – 2012
Amount: $50,000. 100%.

4. *Investigator status:* Principal investigator
   Co-investigator: Robert A. Dalrymple (Johns Hopkins University)
   External agency: Office of Naval Research
   Project title and dates: Hybrid Eulerian and Lagrangian simulation of steep and breaking waves and surface fluxes in high winds, 2009 – 2014
   Amount: $304,029. Approximately 67% (about $202,700) went to Lian Shen.

5. *Investigator status:* Principal investigator
   External agency: Chevron Corporation (through Massachusetts Institute of Technology)
   Project title and dates: Investigation of boundary layer effects on multiscale pipe flows, 2009 – 2011
   Amount: $10,000. 100%.

6. *Investigator status:* Principal investigator
   External agency: Office of Naval Research
   Project title and dates: Development of a highly efficient and accurate wind-wave simulation framework for operational data assimilation, 2008 – 2012
   Amount: $181,886. 100%.

7. *Investigator status:* Senior investigator
   Name of PI: Lori Graham-Brady (Johns Hopkins University)
   External agency: National Science Foundation
   Project title and dates: IGERT: Modeling complex systems - the scientific basis of coupling multi-physics models at different scales, 2008 – 2013
   Amount: $3,000,000. Allocation of budget unspecified in proposal. Lian Shen is one of the 21 participating faculty members.

8. *Investigator status:* Principal investigator
   External agency: Office of Naval Research
   Project title and dates: High-resolution measurement-based phase-resolved prediction of ocean wavefields, 2006 – 2007
   Amount: $5,012. 100%.

9. *Investigator status:* Co-investigator
   Name of PI: Robert A. Dalrymple (Johns Hopkins University)
   Other co-investigators: Samuel J. Bentley (Louisiana State University), Gail C. Kineke (Boston College), Yuming Liu (Massachusetts Institute of Technology), Chiang C. Mei (Massachusetts Institute of Technology), Peter Traykovski (Woods Hole Oceanographic Institution), John Trowbridge (Woods Hole Oceanographic Institution), Dick K.P. Yue (Massachusetts Institute of Technology)
   External agency: Office of Naval Research
   Project title and dates: MURI: Mechanisms of fluid-mud interactions under waves, 2006 – 2012
   Amount: $5,000,000. Approximately 8% (about $400,000) went to Lian Shen.

10. *Investigator status:* Principal investigator

External agency: Office of Naval Research
Project title and dates: YIP: Multiscale deterministic wave modeling with wind input and wave breaking dissipation, 2006 – 2009
Amount: $300,000. 100%.

11. *Investigator status:* Principal investigator
External agency: Office of Naval Research
Project title and dates: A direct simulation-based study of radiance in a dynamic ocean, 2005 – 2012
Amount: $527,845. 100%.

12. *Investigator status:* Principal investigator
External agency: Office of Naval Research
Project title and dates: Numerical investigation of coupled air-water turbulent boundary layers at small scales, 2004 – 2007
Amount: $157,271. 100%.

Publications

Convention of authorship: the first author is usually the student performing the study, and the last author is usually the advisor.
*: papers based on student thesis work or postdoc research supervised by Lian Shen.

Books or Monographs

1. Shen, L. (2010), "Numerical study of wave-turbulence interaction," book chapter in *Notes on Numerical Fluid Mechanics and Multidisciplinary Design: Turbulence and Interactions* (edited by M. Deville, T.-H. Le, and P. Sagaut), Springer, ISBN978-3-642-14138-6.
2. Shen, L. (2007), "Physics of free-surface turbulence and challenges to LES," book chapter in *CFD of Multifluid Flows* (edited by J.-M. Buchlin and P. Rambaud), von Karman Institute for Fluid Dynamics, ISSN0377-8312.

Refereed Journal Articles

Papers submitted:

1. *Yang, Z., Lu, X., Guo, X., Liu, Y. & Shen, L., "LES study of sediment suspension and transport under plunging breaking waves."
2. *Yang, D. & Shen, L., "Numerical simulation of scalar transport in turbulent flows over progressive surface waves."
3. *Liu, C., Shen, L. & Dong, Y, "Characteristics of momentum and energy transport in particle-laden turbulent flow."
4. *Deng, B., Hu, Y., Guo, X., Dalrymple, A. & Shen, L. "Direct numerical simulation of water wave propagating over viscous fluid mud."
5. *Calderer, A., Guo, X., Shen, L. & Sotiropoulos, F., "Fluid-structure interaction simulation of floating structure interacting with complex, large-scale ocean waves and atmospheric turbulence."
6. *Liu, C., Tang, S., Dong, Y. & Shen, L., "Heat transfer modulation by inertial particles in particle-laden turbulent channel flow."

7. *Cui, Z., Yang, Z., Shen, L. & Jiang, H., "Complex modal analysis of the movement of swimming fish propelled by body and/or caudal fin."
8. Wang, Q. et al., "CASPER: a multidisciplinary program on the coupled air-sea processes and electromagnetic wave (EM) ducting research."

Papers published:

9. *Cui, Z., Yang, Z., Jiang, H., Huang, W. & Shen, L., "A sharp interface immersed boundary method for simulating incompressible flows with arbitrarily deforming smooth boundaries," *International Journal of Computational Methods*, in press.
10. *Xuan, A., Deng, B., Cao, T. & Shen, L. (2016), "Numerical study on the effects of progressive gravity waves on turbulence," *Journal of Hydrodynamics,* Vol. 28(6), 840-847.
11. *Xie, S., Yang, D., Liu, Y. & Shen, L. (2016), "Simulation-based study of wind loads on semi-submerged object in ocean wave field," *Physics of Fluids,* Vol. 28, 015106, 24 pages.
12. *Witt, A., Gulliver, J. & Shen, L. (2015), "Simulating air entrainment and bubble dynamics in a hydraulic jump," *International Journal of Multiphase Flow*, Vol. 72, pp.165-180.
13. *Guo, X. & Shen, L. (2014), "Numerical study of the effect of surface wave on turbulence underneath. Part 2. Eulerian and Lagrangian properties of turbulence kinetic energy," *Journal of Fluid Mechanics,* Vol. 744, pp.250-272.
14. *Yang, D., Meneveau, C. & Shen, L. (2014), "Large-eddy simulation of offshore wind farm," *Physics of Fluids,* Vol. 26, 025101, 30 pages.
15. *Yang, D., Meneveau, C. & Shen, L. (2014), "Effect of downwind swells on offshore wind energy harvesting – a large-eddy simulation study," *Renewable Energy,* Vol. 70, pp.11-23.
16. *Calderer, A., Guo, X., Shen, L. & Sotiropoulos, F. (2014), "Coupled fluid-structure interaction simulation of floating offshore wind turbines and waves: a large eddy simulation approach," *Journal of Physics,* Vol. 524, 012091, 10 pages.
17. *Guo, X. & Shen, L. (2013), "Numerical study of the effect of surface wave on turbulence underneath. Part 1. Mean flow and turbulence vorticity," *Journal of Fluid Mechanics*, Vol. 733, pp.558-587.
18. *Yang, D., Meneveau, C. & Shen, L. (2013), "Dynamic modeling of sea-surface roughness for large-eddy simulation of wind over ocean wavefield," *Journal of Fluid Mechanics,* Vol. 726, pp.62-99.
19. *Yang, D., Shen, L. & Meneveau, C. (2013), "An assessment of dynamic subgrid-scale sea-surface roughness model," *Flow, Turbulence and Combustion,* Vol. 91, pp.541-563.
20. *Hu, Y., Guo, X., Lu, X., Liu, Y., Dalrymple, R.A. & Shen, L. (2012), "Idealized numerical simulation of breaking water wave propagating over a viscous mud layer," *Physics of Fluids*, Vol. 24, 112104, 20 pages.
21. Dickey, T. *et al.* (2012), "Introduction to special section on recent advances in the study of optical variability in the near-surface and upper ocean," *Journal of Geophysical Research – Oceans*, Vol. 117, C00H20, 39 pages.
22. *Khakpour, H.R., Igusa T. & Shen, L. (2012), "Coherent vortical structures responsible for strong flux of scalar at free surface," *International Journal of Heat and Mass Transfer,* Vol. 55, pp.5157-5170.
23. *Xu, Z., Guo, X., Shen, L. & Yue, D.K.P. (2012), "Radiative transfer in ocean turbulence and its effect on underwater light field," *Journal of Geophysical Research – Oceans*, Vol. 117, C00H18, 14 pages.

24. *Kermani, A., Khakpour, H.R., Shen, L. & Igusa T. (2011), "Statistics of surface renewal of passive scalars in free-surface turbulence," *Journal of Fluid Mechanics,* Vol. 678, pp.379-416.
25. *Khakpour, H.R., Shen, L. & Yue, D.K.P. (2011), "Transport of passive scalar in turbulent shear flow under a clean or surfactant-contaminated free surface," *Journal of Fluid Mechanics,* Vol. 670, pp.527-557.
26. *Yang, D. & Shen, L. (2011), "Simulation of viscous flows with undulatory boundaries: Part II. Coupling with other solvers for multi-fluids computation," *Journal of Computational Physics,* Vol. 230, pp.5510-5531.
27. *Yang, D. & Shen, L. (2011), "Simulation of viscous flows with undulatory boundaries: Part I. Basic solver," *Journal of Computational Physics,* Vol. 230, pp. 5488-5509.
28. *Xu, Z., Yue, D.K.P., Shen, L. & Voss, K. (2011), "Patterns and statistics of in-water polarization under conditions of linear and nonlinear ocean surface waves," *Journal of Geophysical Research - Oceans,* Vol. 116, C00H12, 14 pages.
29. *Guo, X. & Shen, L. (2010), "Interaction of a deformable free surface with statistically-steady homogeneous turbulence," *Journal of Fluid Mechanics,* Vol. 658, pp.33-62.
30. *Yang, D. & Shen, L. (2010), "Direct-simulation-based study of turbulent flow over various waving boundaries," *Journal of Fluid Mechanics,* Vol. 650, pp.131-180.
31. *Liu, Y., Yang, D., Guo, X. & Shen, L. (2010), "Numerical study of pressure forcing of wind on dynamically evolving water waves," *Physics of Fluids,* Vol. 22, 041704, 4 pages.
32. *Yang, D. & Shen, L. (2009), "Characteristics of coherent vortical structures in turbulence over water waves," *Physics of Fluids,* Vol. 21, 125106, 23 pages.
33. *Liu, S., Kermani, A., Shen, L. & Yue, D.K.P. (2009), "Investigation of coupled air-water turbulent boundary layers using direct numerical simulations," *Physics of Fluids,* Vol. 21, 062108, 19 pages.
34. *Kermani, A. & Shen, L. (2009), "Surface age of surface renewal in turbulent interfacial transport," *Geophysical Research Letters,* Vol. 36, L10605, 5 pages.
35. *Guo, X. & Shen, L. (2009), "On the generation and maintenance of waves and turbulence in simulations of free-surface turbulence," *Journal of Computational Physics,* Vol. 228, pp.7313-7332.
36. Edson, J.B. *et al.* (2007), "The coupled boundary layers and air-sea transfer experiment in low winds (CBLAST-LOW)," *Bulletin of the American Meteorology Society,* Vol. 88(3), pp.341-356.
37. Shen, L. & Yue, D.K.P. (2006), "Modeling the relationships between flow statistics and structures at the coupled air-ocean interface," *Oceanography,* Vol. 19(1), pp.52-63.
38. Shen, L., Triantafyllou, G.S. & Yue, D.K.P. (2004), "Effects of surfactants on free-surface turbulent flows," *Journal of Fluid Mechanics,* Vol. 506, pp.79-115.
39. Shen, L., Zhang, X., Triantafyllou, M.S. & Yue, D.K.P. (2003), "Turbulent flow over a flexible wall undergoing a streamwise traveling wave motion," *Journal of Fluid Mechanics,* Vol. 484, pp.197-221.
40. Shen, L., Zhang, C. & Yue, D.K.P. (2002), "Free-surface turbulent wake behind towed ship models – experimental measurements, stability analyses and direct numerical simulations," *Journal of Fluid Mechanics,* Vol. 469, pp. 89-120.
41. Shen, L. & Yue, D.K.P. (2001), "Large-eddy simulation of free-surface turbulence," *Journal of Fluid Mechanics,* Vol. 440, pp.75-116.
42. Shen, L., Triantafyllou, G.S. & Yue, D.K.P. (2001), "Mixing of a passive scalar near a free surface," *Physics of Fluids,* Vol. 13(4), pp.913-926.
43. Shen, L., Triantafyllou, G.S. & Yue, D.K.P. (2000), "Turbulent diffusion near a free surface," *Journal of Fluid Mechanics,* Vol. 407, pp.145-166.

44. Shen, L., Zhang, X., Yue, D.K.P. & Triantafyllou, G.S. (1999), "The surface layer for free-surface turbulent flows," *Journal of Fluid Mechanics,* Vol. 386, pp.167-212.
45. Zhang, C., Shen, L. & Yue, D.K.P. (1999), "The mechanism of vortex connection at a free surface," *Journal of Fluid Mechanics*, Vol. 384, pp.207-241.

In preparation:

46. *Hao, X. & Shen, L., "Numerical investigation of energy transfer in coupled wind and wave system."
47. *Deng, B., Xuan, A. & Shen, L., "Influence of Langmuir circulations on near-bottom turbulence in shallow water."
48. *Yang, Z. & Shen, L., "Direct numerical simulation of airflow over breaking waves."
49. *Xuan, A. & Shen, L., "A conservative scheme for simulation of free-surface turbulent and wave flows."
50. *Witt, A., Gulliver, J. & Shen, L., "Numerical investigation of turbulent air-water interactions and bubble behavior in steady air entrainment hydraulic jump."
51. *Cui, Z., Yang, Y., Jiang, H. & Shen, L., "Hydrodynamics analysis of tethered anguilliform fish interacting with 2D complex incompressible flows."
52. *Cui, Z., Yang, Y., Jiang, H. & Shen, L., "Study of propulsive performance in undulating locomotion of Carangiform fish."
53. *Tang, S., Yang, Y., Dong, Y. & Shen, L., "Numerical study on the motion of sea spray droplets over breaking waves."

Refereed Conference Proceedings

1. *Guo, X., Xuan, A. & Shen, L. (2014), "Numerical and theoretical investigations of wave effect on upper-ocean turbulence," *Proceedings of 30th Symposium on Naval Hydrodynamics*.
2. *Shen, L., Xie, S., Yang, D. & Liu, Y. (2014), "Wind-and-wave simulations with dynamic modeling for ship hydrodynamics applications," *Proceedings of 30th Symposium on Naval Hydrodynamics*.
3. *Yang, D., Meneveau, C. & Shen, L. (2013), "Large-eddy simulation based study of offshore wind turbine array boundary layers," *Proceedings of 2013 International Conference on Aerodynamics of Offshore Wind Energy Systems and Wakes*.
4. *Hu, Y., Liu, Y., Guo, X. & Shen, L. (2011), "Numerical study of wave breaking over a muddy seabed," *Proceedings of 6th International Conference on Asia and Pacific Coasts*.
5. *Liu, Y., Guo, X., Yang, D. & Shen, L. (2010), "Numerical simulation of strong free-surface turbulence for mechanistic study," *Proceedings of 28th Symposium on Naval Hydrodynamics*.
6. *Xie, S., Liu, Y., Yang, D., Guo, X. & Shen, L. (2010), "Numerical simulation of wind-wave-structure interaction," *Proceedings of 28th Symposium on Naval Hydrodynamics*.
7. *Liu, Y., Yang, D., Guo, X. & Shen, L. (2010), "Multi-scale modeling of wind-wave interaction in the presence of offshore structures for renewable energy applications," *Proceedings of the ASME 29th International Conference on Ocean, Offshore and Arctic Engineering.*
8. *Guo, X., Yang, D., Liu, Y. & Shen, L. (2010), "Mechanistic study of upper ocean turbulence interacting with surface waves," *Proceedings of the ASME 29th International Conference on Ocean, Offshore and Arctic Engineering.*
9. *Shen, L., Yang, D. & Yue, D.K.P. (2008), "Coupled wind-wave prediction for ship motion," *Proceedings of 27th Symposium on Naval Hydrodynamics*.

10. *Shen, L., Liu, S. & Yue, D.K.P. (2005), "Mechanisms of air-sea interactions at small scales," *Proceedings of Civil Engineering in the Ocean VI.*
11. *Liu, S., Hendrickson, K., Dong, X., Shen, L. & Yue, D.K.P. (2004), "Numerical investigation of coupled boundary layers air-sea transfer (CBLAST) at small scales," *Proceedings of the 16th Symposium on Boundary Layers and Turbulence*.
12. Hendrickson, K., Shen, L., Yue, D.K.P., Dommermuth, D.G. & Adams P. (2003), "Simulation of steep breaking waves and spray sheets around a ship: the last frontier in computational ship hydrodynamics," *Proceedings of the DoD High Performance Computing Users Group Conference*.

Presentations

Invited Presentations at Professional Meetings, Conferences, Universities and Industries, etc. (Selected with a Focus on after Lian Shen Joined UMN in 2012)

1. Shen, L. & Marr, J., "University of Minnesota wind and water power research program," *Invited Presentation at the Sandia National Laboratories*, Albuquerque, NM, 2016
2. Shen, L., Xuan, A. Deng, B. & Cao, T. "Numerical study on the effects of progressive gravity waves on turbulence," *Keynote Presentation at the 2nd Conference of Global Chinese Scholars on Hydrodynamics*, Wuxi, China, 2016.
3. Shen, L., "Simulation based study of effects of water waves on turbulence," *Invited Seminar at University of Notre Dame*, Notre Dame, IN, 2016.
4. Shen, L., "High-fidelity CFD and its applications in fluid mechanics study," *Invited Seminar at University of Science and Technology of China*, Hefei, China, 2016.
5. Shen, L., Xuan, A. & Cao, T. "Simulation of wave effects on turbulence," *Keynote Presentation at the 7th International Conference of Computational Methods*, Berkeley, CA, 2016.
6. Shen, L., "Study of upper-ocean turbulence using high-resolution wave-resolved simulations," *Invited Seminar at University of Wisconsin*, Madison, WI, 2016.
7. Shen, L., "Simulation-based study of ocean surface waves and interaction with turbulence," *Invited Seminar at Tongji University*, Shanghai, China, 2016.
8. Shen, L., "Study of upper ocean processes using high-resolution wave-resolved simulations," *Invited Seminar at Xiamen University*, Xiamen, China, 2016.
9. Shen, L., "Simulation-based study of ocean surface waves and interaction with turbulence," *Invited Seminar at Ocean University of China*, Qingdao, China, 2016.
10. Shen, L., "Simulation-based mechanistic study of turbulence-wave interaction," *Invited Seminar in St. Anthony Falls Laboratory at University of Minnesota*, Minneapolis, MN, 2016.
11. Shen, L., "Physics-based simulations of wave-ocean-wind interaction processes related to oil spill transport," *Invited Talk at Oil Spill and Ecosystem Science Conference*, Houston, TX, 2015.
12. Shen, L., "Simulation-based study of wave effects on marine atmospheric boundary layer," *Invited Talk at AGU Fall Meeting*, San Francisco, CA, 2015.
13. Shen, L., "Simulation-based study of turbulence in ocean wave environment," *Invited Talk at* the *Annual Conference of the State Key Laboratory for Turbulence and Complex Systems of Peking University*, Beijing, China, 2015.
14. Yang, X., Khosronejad, A., Chawdhary, S., Calderer, A., Angelidis, D., Shen, L. & Sotiropoulos, F., "Simulation-Based Approach for Site-Specific Optimization of Marine and Hydrokinetic Energy Conversion Systems," *Invited Talk at the 36th IAHR World Congress*, Hague, Netherlands, 2015.

15. Shen, L., "Computational fluid dynamics for environmental fluid flows," *Invited Seminar at Institution of Earth Environment*, Xi'an, China, 2015.
16. Shen, L., "Computational fluid dynamics for environmental and Renewable Energy Studies," *Invited Seminar at Xi'an Jiaotong University*, Xi'an, China, 2015.
17. Shen, L., "Computational fluid dynamics for Ocean Science and Engineering Studies," *Invited Seminar at Shanghai Jiaotong University*, Shanghai, China, 2015.
18. Shen, L., "Simulation-based study of turbulence boundary layer flows at wavy surfaces and near gas-liquid interfaces," *Invited Seminar at Shanghai Jiaotong University*, Shanghai, China, 2015.
19. Shen, L., "Simulations of waves and turbulent flows for ocean engineering applications," *Invited Seminar at Huazhong University of Science and Technology*, Wuhan, China, 2015.
20. Shen, L., "Simulation of turbulence boundary-layer flows at wavy surfaces," *Invited Seminar at Sichuan University*, Chengdu, China, 2015.
21. Shen, L., "Simulations of waves and turbulent flows for ocean engineering applications," *Invited Seminar at Zhejiang University*, Hangzhou, China, 2015.
22. Shen, L., "Progress in wave-ocean-wind (WOW) simulations and thoughts on experiment-simulation collaboration," *Invited Talk at Phase Resolved Wave Modeling Working Group Meeting at University of Miami*, Miami, FL, 2015.
23. Hogan, C., Shen, L. & Ouyang, H. "Monte Carlo based approaches to predicting filtration efficiencies," *Invited Presentation in the Donaldson Inc.*, Minneapolis, MN, 2015.
24. Shen, L., "Simulation-based study of turbulence in ocean wave environment," *Invited Seminar in Department of Aerospace Engineering and Mechanics at University of Minnesota*, Minneapolis, MN, 2014.
25. Shen, L., "Mechanistic study of turbulence boundary-layer flows at wavy surfaces," *Invited Seminar at Tsinghua University*, Beijing, China, 2013.
26. Shen, L., "Simulation based study of boundary-layer flows at wave surfaces," *Invited Seminar at University of Science and Technology of China*, Hefei, China, 2013.
27. Shen, L., "Coupled computation of wind and wave fields," *Invited Seminar at Naval Research Laboratory*, Monterey, CA, 2013.
28. Shen, L., "Simulations of radiative transfer in aquatic environment," *Invited Seminar at Monterey Bay Aquarium Research Institute*, Moss Landing, CA, 2013.
29. Shen, L., "Numerical study of turbulence-wave interaction," *Keynote Presentation at the 2nd International Conference on Turbulence and Interactions*, Sainte-Luce, Martinique, 2009.
30. Shen, L., "Simulation based study of wind-wave interaction," *14th T. Francis Ogilvie Young Investigator Lecture*, Cambridge, MA, 2009.

Selected Contributed Papers Presented at Professional Meetings, Conferences, etc.

Convention of authorship: the first author is usually the student performing the study, and the last author is usually the advisor.
*: presentations based on student thesis work or postdoc research supervised by Lian Shen
Underline: presenter

31. *Yang, Z., Xuan, A., Deng, B., Drennan W., Haus, B. & Shen, L., "Simulation of wind-wave-current interactions for oil spill applications," *Oil Spill and Ecosystem Science Conference*, New Orleans, LA, 2017.
32. *Calderer, A., Hao, X., Fernando, H.J., Sotiropoulos, F. & Shen, L., "Data-informed large-eddy simulation of coastal land-air-sea interactions," *AGU Fall Meeting*, San Francisco, CA, 2016.

33. Yang, Z. & Shen, L., "DNS of airflow over breaking waves," *69th American Physical Society Division of Fluid Dynamics Annual Meeting*, Portland, OR, 2016.
34. Cao, T. & Shen, L., "Direct numerical simulation of wind over two progressive waves," *69th American Physical Society Division of Fluid Dynamics Annual Meeting*, Portland, OR, 2016.
35. Chawdhary, S., Angeldis, D., Shen, L. & Sotiropoulos, F., "Field scale simulation of axial-flow hydrokinetic turbines in a natural marine environment," *69th American Physical Society Division of Fluid Dynamics Annual Meeting*, Portland, OR, 2016.
36. Angeldis, D., Shen, L. & Sotiropoulos, F., "Fluid-structure interaction of complex bodies in two-phase flows on locally refined grids," *69th American Physical Society Division of Fluid Dynamics Annual Meeting*, Portland, OR, 2016.
37. Xuan, A. & Shen, L., "Numerical study of interactions between surface waves and turbulence underneath using phase-resolved simulations," *69th American Physical Society Division of Fluid Dynamics Annual Meeting*, Portland, OR, 2016.
38. Foti, D., Yang, X., Shen, L. & Sotiropoulos, F., "A numerical investigation of the role of the turbine rotor scale and the nacelle on wake meandering," *69th American Physical Society Division of Fluid Dynamics Annual Meeting*, Portland, OR, 2016.
39. Han, L., Xiao, Z. & Shen, L., "Numerical study on the interaction between supercavitation and turbulence," *69th American Physical Society Division of Fluid Dynamics Annual Meeting*, Portland, OR, 2016.
40. Hao, X. & Shen, L., "Numerical investigation of the energy transfer in a coupled wind and wave system," *69th American Physical Society Division of Fluid Dynamics Annual Meeting*, Portland, OR, 2016.
41. *Cao, T. & Shen, L., "LES of stratified marine atmospheric boundary layer over waves," *20th Air-Sea Interaction Conference*, Madison, WI, 2016.
42. *Liu, C., Tang, S., Dong, Y. & Shen, L., "Numerical investigation of the impact of sea spray droplets on air-sea boundary layer," *20th Air-Sea Interaction Conference*, Madison, WI, 2016.
43. *Wang, Q. et al., "Air-sea interaction related to characterizing electromagnetic wave propagation in the atmosphere – CASPER science objectives and measurement strategy," *20th Air-Sea Interaction Conference*, Madison, WI, 2016.
44. Drennan, W. & Shen, L., "Investigation of oil spill transport in a coupled wind-wave-current environment using simulation and laboratory studies," *Oil Spill and Ecosystem Science Conference*, Tampa, FL, 2016.
45. *Xuan, A., Deng, B. & Shen, L., "Numerical investigation of interactions between surface waves and upper-ocean turbulence," *2016 Ocean Sciences Meeting*, New Orleans, LA, 2016.
46. *Calderer, A., Hao, X., Yang, Z., Sotiropoulos, F. & Shen, L., "Simulation of wind and waves with complex land topography," *2016 Ocean Sciences Meeting*, New Orleans, LA, 2016.
47. Wang, Q. et al. "The design of CASPER field program for EM ducting research," *NSNC-URSI National Radio Science Meeting*, Boulder, CO, 2016.
48. Shen, L., "Current status of coupled LES modeling for EM propagation study," *CASPER Data Workshop*, Columbus, OH, 2016.
49. Shen, L., "Phase-resolve wave modeling and coupling with LES," *ONR Langmuir DRI Discussion and Planning Meeting*, La Jolla, CA, 2016.
50. Shen, L., "Progress in wave-ocean-wind (WOW) simulations and thoughts on experiment-simulation collaboration," *Phase Resolved Wave Modeling Working Group Meeting*, Miami, FL, 2015.
51. Fringer, O., Ko, D. & Shen, L., "A multiscale nested modeling framework to simulate the interaction

of surface gravity waves with nonlinear internal gravity waves," *NOPP Seamless Forecasting from Deep Ocean to the Coast Meeting*, Washington, DC, 2015.

52. Shen, L., "Simulations of ocean waves and near surface turbulence processes," *International Conference on Model Integration across Disparate Scales in Complex Turbulent Flow Simulation (ICMIDS)*, State College, PA, 2015.
53. *Yang, Z. & Shen, L., "Interactions of steep and breaking waves with solid bodies," *68th American Physical Society Division of Fluid Dynamics Annual Meeting*, Boston, MA, 2015.
54. *Yang, D. & Shen, L., "Effect of progressive surface waves on near-surface transport of scalar by turbulent wind," *68th American Physical Society Division of Fluid Dynamics Annual Meeting*, Boston, MA, 2015.
55. *Hao, X. & Shen, L., "Simulation-based study of air-sea momentum fluxes nearshore," *68th American Physical Society Division of Fluid Dynamics Annual Meeting*, Boston, MA, 2015.
56. *Calderer, A., Guo, X., Shen, L. & Sotiropoulos, F., "On the coupling of far-field wind-wave simulation and near-field free-surface flow simulation," *SIAM Conference on Computational Science and Engineering*, Salt Lake City, UT, 2015.
57. Shen, L., "Fine-scale modeling on air-sea-wave interaction in surface layer," *CASPER MURI Meeting*, Monterey, CA, 2015.
58. Wang, Q., Burkholder, R., Fernando, H., Khelif, D., Shearman, R. & Shen, L."Coupled air-sea processes and EM ducting research (CASPER)," *19th Conference on Air-Sea Interaction*, Phoenix, AZ, 2015.
59. Shen, L., "Simulations of wind-wave and wave-ocean interactions," *Phase Resolved Wave Modeling Working Group Meeting*, Miami, FL, 2014.
60. *Shen, L., Xie, S., Yang, D. & Liu, Y., "Wind-and-wave simulations with dynamic modeling for ship hydrodynamics applications," *The 30th Symposium on Naval Hydrodynamics*, Hobart, Australia, 2014.
61. *Guo, X., Xuan, A. & Shen, L., "Numerical and theoretical investigations of wave effect on upper-ocean turbulence," *The 30th Symposium on Naval Hydrodynamics*, Hobart, Australia, 2014.
62. *Calderer, A., Guo, X., Shen, L. & Sotiropoulos, F., "Coupled fluid-structure interaction simulation of floating offshore wind turbines and waves: a large eddy simulation approach," *The Science of Making Torque from Wind*, Copenhagen, Denmark, 2014.
63. *Yang, D., Liu, L. & Shen, L., "Coupled wind LES and ocean wave simulations with actuator disk or line models for offshore wind farm study," *11th World Congress on Computational Mechanics*, Barcelona, Spain, 2014.
64. *Calderer, A., Guo, X., Shen, L. & Sotiropoulos, F., "Fluid-structure interaction simulation of floating wind turbines interacting with complex, large-scale ocean waves ," *11th World Congress on Computational Mechanics*, Barcelona, Spain, 2014.
65. *Guo, X. & Shen, L., "Simulation of interaction between surface waves and upper ocean turbulence," 2014 *Ocean Sciences Meeting*, Honolulu, HI, 2014.
66. *Witt, A., Gulliver, J. & Shen, L., "CFD modeling of dissolved gas transfer at a hydraulic jump", *HydroVision International Conference*, Nashville, TN, 2014.
67. Shen, L., "Computer simulation study of wind energy at sea," *Defense Energy Summit*, Austin, TX, 2013.
68. *Guo, X. & Shen, L., "Eulerian and Lagrangian effects of surface wave on turbulence underneath," *66th American Physical Society Division of Fluid Dynamics Annual Meeting*, Pittsburg, PA, 2013.
69. *Yang, D., Meneveau, C. & Shen, L., "Numerical study of ocean wave effect on offshore wind

farm," *66th American Physical Society Division of Fluid Dynamics Annual Meeting*, Pittsburg, PA, 2013.

70. *Lu, X., Guo, X., Liu, Y. & Shen, L., "Suspension and transport of sediment under a plunging wave breaker," *66th American Physical Society Division of Fluid Dynamics Annual Meeting*, Pittsburg, PA, 2013.
71. *Guo, X. & Shen, L., "Numerical study of turbulence under progressive surface wave," *AGU Fall Meeting*, San Francisco, CA, 2013.
72. *Yang, D., Meneveau, C. & Shen, L., "Large-eddy simulation based study of offshore wind turbine array boundary layers," *International Conference on Aerodynamics of Offshore Wind Energy Systems and Wakes*, Copenhagen, Denmark, 2013.
73. *Guo, X. & Shen, L., "Simulation-based study of wave-turbulence interaction," *23rd International Congress of Theoretical and Applied Mechanics*, Beijing, China, 2012.
74. *Shen, L., Yang, D. & Meneveau, C., "Development and assessment of dynamic water-surface roughness model for large-eddy simulation of winds," *65th American Physical Society Division of Fluid Dynamics Annual Meeting*, San Diego, CA, 2012.
75. *Yang, D., Meneveau, C. & Shen, L., "Simulation based study of the effect of ocean waves on floating wind farm," *65th American Physical Society Division of Fluid Dynamics Annual Meeting*, San Diego, CA, 2012.
76. *Yang, D., Meneveau, C. & Shen, L., "Dynamic modeling of sea-surface roughness for large-eddy simulation of wind over ocean surface waves," *2012 Ocean Sciences Meeting*, Salt Lake City, Utah, 2012.
77. *Guo, X. & Shen, L., "Numerical study of the influence of surface waves on turbulence in the upper ocean," *2012 Ocean Sciences Meeting*, Salt Lake City, Utah, 2012.
78. *Meneveau, C., Anderson, W., Yang, D. & Shen, L., "A dynamic surface roughness model for LES & applications to turbulent flow over static and moving multi-scale surfaces," *KAVLI Institute for Theoretical Physics China (KITPC) Workshop "New Directions in Turbulence"*, Beijing, China, 2012.
79. *Yang, D., Meneveau, C., Walters, R., Valenciano, M., Stephens, M., Hand, R. & Shen, L., "LES of floating wind farms," *64th American Physical Society Division of Fluid Dynamics Annual Meeting*, Baltimore, MD, 2011. Video presentation for Gallery of Fluid Motion, available online at http://arxiv.org/abs/1110.3276.
80. *Yang, D. & Shen, L., "Direct numerical simulation of scalar transport in turbulent flows over progressive water waves," *64th American Physical Society Division of Fluid Dynamics Annual Meeting*, Baltimore, MD, 2011.
81. *Guo, X. & Shen, L., "Numerical study of interaction of turbulence with free surface and wave," *64th American Physical Society Division of Fluid Dynamics Annual Meeting*, Baltimore, MD, 2011.
82. *Xie, S. & Shen, L., "Simulation-based study of wind load on surface-piercing body and its dependency on waves," *64th American Physical Society Division of Fluid Dynamics Annual Meeting*, Baltimore, MD, 2011.
83. *Liu, Y., Shen, L. & Dalrymple, R.A., "Numerical simulation of wind-wave evolution and breaking," *64th American Physical Society Division of Fluid Dynamics Annual Meeting*, Baltimore, MD, 2011.
84. *Hu, Y., Guo, X., Liu, Y., Shen, L. & Dalrymple, R.A., "Numerical study of non-breaking and breaking surface waves over viscous mud flow," *64th American Physical Society Division of Fluid Dynamics Annual Meeting*, Baltimore, MD, 2011.
85. *Khakpour, H., Shen, L. & Igusa, T., "Statistical study of scalar transport in wind-driven free-

surface turbulent flows," *64th American Physical Society Division of Fluid Dynamics Annual Meeting*, Baltimore, MD, 2011.

86. *Guo, X. & Shen, L., "Simulation of turbulence interacting with free-surface and wave," *63rd American Physical Society Division of Fluid Dynamics Annual Meeting*, Long Beach, CA, 2010.
87. *Liu, Y., Guo, X., Yang, D. & Shen, L., "Numerical simulation of strong free-surface turbulence for mechanistic study," *28th Symposium on Naval Hydrodynamics*, Pasadena, CA, 2010.
88. *Xie, S., Liu, Y., Yang, D., Guo, X. & Shen, L., "Numerical simulation of wind-wave-structure interaction," *28th Symposium on Naval Hydrodynamics*, Pasadena, CA, 2010.
89. *Liu, Y., Xie, S., Yang, D., Guo, X. & Shen, L., "Multi-scale modeling of wind-wave interaction in the presence of offshore structure for renewal energy applications," *29th International Conference on Ocean, Offshore and Arctic Engineering (OMAE2010)*, Shanghai, China, 2010.
90. *Guo, X., Yang, D., Liu, Y. & Shen, L., "Mechanistic study of upper ocean turbulence interacting with surface waves," *29th International Conference on Ocean, Offshore and Arctic Engineering (OMAE2010)*, Shanghai, China, 2010.
91. Shen, L., "Modeling of radiance in a dynamic ocean," *ONR Santa Barbara RaDyO Workshop*, Santa Barbara, CA, 2010.
92. Shen, L., "Direct simulations of wind-wave-ocean interactions," *NSF Workshop on Air-Sea Interactions under Tropical Cyclones (Hurricanes)*, University of Rhode Island, RI, 2010.
93. Shen, L., "A direct simulation-based study of radiance in a dynamic ocean," *ONR Ocean Optics Symposium*, Portland, OR, 2010.
94. Shen, L., "Study of wave-turbulence interaction for the prediction of ocean wave fields," *ONR Waves and Radar Workshop*, La Jolla, CA, 2010.
95. *Xu, Z., Guo, X., Yang, D., Shen, L., Liu, Y. & Yue, D.K.P., "Simulation of underwater radiative transfer with varying refractive index and IOP's in the presence of ocean turbulence," *2010 Ocean Sciences Meeting*, Portland, OR, 2010.
96. *Shen, M., Xu, Z., Liu, Y., Shen, L. & Yue, D.K.P., "Underwater light polarization distribution and short-term fluctuation induced by nonlinear ocean surface waves," *2010 Ocean Sciences Meeting*, Portland, OR, 2010.
97. Shen, L., "Phase-resolved simulation of turbulence-wave interaction for deterministic prediction of wavefield evolution," *Workshop on Deterministic Measurement and Simulation of Ocean Waves*, Delft, Netherlands, 2009.
98. *Kermani, A. & Shen, L., "Direct numerical simulation of scalar transport in free-surface turbulence with applications to air-sea gas transfer," *AGU Fall Meeting*, San Francisco, CA, 2008.
99. *Guo, X. & Shen, L., "Interaction between deformable free surface and homogeneous turbulence," *61st American Physical Society Division of Fluid Dynamics Annual Meeting*, San Antonio, TX, 2008.
100. *Yang, D., Guo, X. & Shen, L., "A numerical study of wind-wave interaction," *61st American Physical Society Division of Fluid Dynamics Annual Meeting*, San Antonio, TX, 2008.
101. *Kermani, A. & Shen, L., "A numerical study of interfacial turbulent transport of passive scalars," *61st American Physical Society Division of Fluid Dynamics Annual Meeting*, San Antonio, TX, 2008.
102. *Khakpour, H.R. & Shen, L., "Direct simulation of mud flow in bottom boundary layer," *AGU Chapman Conference on Physics of Wave-Mud Interaction*, Amelia Island, FL, 2008.
103. Shen, L., "A direct-simulation based study of radiance in a dynamic ocean," *ONR RaDyO Workshop*, La Jolla, CA, 2008.

104. *Liu, Y., Yang, D., Guo, X. & Shen, L., "Numerical simulations of wind-wave-structure interactions," *ASME International Mechanical Engineering Congress and Exposition*, Boston, MA, 2008.
105. *Shen, L., Yang, D. & Yue, D.K.P., "Coupled wind-wave prediction for ship motion," *27th Symposium on Naval Hydrodynamics*, Seoul, Korea, 2008.
106. *Guo, X., Yang, D., Kermani, A. & Shen, L., "Direct numerical simulation of turbulence interacting with air-sea interface at small scales," *2008 Ocean Sciences Meeting*, Orlando, FL, 2008.
107. *Kermani, A. & Shen, L., "A numerical study of surface renewal statistics at a free surface," *60th American Physical Society Division of Fluid Dynamics Annual Meeting*, Salt Lake City, UT, 2007.
108. *Yang, D. & Shen, L., "Direct numerical simulation of turbulence over wavy surfaces," *60th American Physical Society Division of Fluid Dynamics Annual Meeting*, Salt Lake City, UT, 2007.
109. Shen, L., "Direct simulation based study of fluid-mud interaction under waves," *ONR Mud/MURI Workshop,* Baltimore, MD, 2007.
110. Shen, L., "A direct simulation-based study of radiance in a dynamic ocean," *ONR RaDyO Workshop,* La Jolla, CA, 2007.
111. Yue, D.K.P., Liu, Y. & Shen, L., "High-resolution measurement-based phase-resolved prediction of ocean wavefields," *ONR High Resolution Air-Sea Interaction Workshop,* La Jolla, CA, 2007.
112. Shen, L., "Radiance in a dynamic ocean," *ONR RaDyO Workshop,* Montreal, Quebec, Canada, 2006.
113. Dickey, T. *et al*., "The Radiance in a Dynamic Ocean (RaDyO) Program," *Ocean Optics XVIII Conference*, Montreal, Quebec, Canada, 2006.
114. Shen, L., "Simulations of radiance in a dynamic ocean," *ONR RaDyO Workshop,* Lo Jalla, CA, 2006.
115. Shen, L., "Direct simulation-based study of radiance in a dynamic ocean," *ONR RaDyO Workshop,* Narragansett, RI, 2005.
116. *Shen, L., Liu, S. & Yue, D.K.P., "Mechanisms of air-sea interactions at small scales," *Civil Engineering in the Ocean VI*, Baltimore, MD, 2005.
117. *Liu, S., Hendrickson, K., Dong, X., Shen, L. & Yue, D.K.P., "Numerical investigation of coupled boundary layers air-sea transfer (CBLAST) at small scales," *16th Symposium on Boundary Layers and Turbulence and 13th Conference on Interactions of the Sea and Atmosphere*, Portland, ME, 2004.
118. Hendrickson, K., Liu, S., Shen, L. & Yue, D.K.P., "Numerical investigation of coupled air-water turbulent boundary layers at small scales," *2004 Ocean Sciences Meeting*, Portland, OR, 2004.

TEACHING AND CURRICULUM DEVELOPMENT

University of Minnesota

- ME3332 Thermal Science II - Fluid Mechanics (undergraduate)
- ME5332 Intermediate Fluid Mechanics (undergraduate and graduate)
- ME5344 Thermodynamics for Fluid Flow with Applications (undergraduate and graduate)
- ME8332 Advanced Fluid Mechanics in Mechanical Engineering (graduate)
- ME8342 Convection (graduate)

Johns Hopkins University

- EN.560/570.351 Introduction to Fluid Mechanics (undergraduate)
- EN.560.380 Introduction to Ocean and Wind Engineering (undergraduate)
- EN.560.782 Hydrodynamics (graduate)
- EN.560.783 Hydrodynamic Loads on Structures and Ships (graduate)
- EN.560.700 Applications of Science-Based Coupling of Models (graduate), team taught.
- EN.560.703 Modeling Complex Systems Colloquium (graduate), team taught.

von Karman Institute of Fluid Dynamics, Belgium

- CFD of Multifluid Flow (short course for graduate students, postdocs, and professionals), team taught.

Curriculum Development

New courses developed at University of Minnesota

- ME5332 Intermediate Fluid Mechanics (undergraduate and graduate)
  Course proposed and approved in 2015, taught by Lian Shen in Fall 2016 for its first time offered.
- ME8332 Advanced Fluid Dynamics in Mechanical Engineering (graduate)
  Course proposed and approved in 2015, currently being taught by Lian Shen in Spring 2017 for its first time offered.

New courses developed previously at Johns Hopkins University

- EN.560.380 Introduction to Ocean and Wind Engineering (undergraduate)
- EN.560.782 Hydrodynamics (graduate)
- EN.560.783 Hydrodynamic Loads on Structures and Ships (graduate)
- EN.560.700 Applications of Science-Based Coupling of Models (graduate), team effort.
- EN.560.703 Modeling Complex Systems Colloquium (graduate), team effort.

Collaborative Efforts and Activities

- Member of ABET ME3332 review committee, 2016.
- Leader of the Fluid Mechanics teaching group in Department of Mechanical Engineering, 2015 – present. Responsibilities include coordinating the development and improvement of fluid mechanics courses in the department.
- Member of Committee on Teaching of Numerical Methods in Department of Mechanical Engineering, 2016 – present.

ADVISING AND MENTORING

Summary:

Current: 2 postdoctoral associates, 11 PhD students of UMN, and 7 visiting PhD students spending two years at UMN.

Completed: 4 postdoctoral associates (1 at JHU and 3 at UMN), 9 PhD students graduated with Lian Shen serving as advisor or co-advisor (5 earned degrees from JHU, 1 from Wuhan University, and 3 from UMN).

Undergraduate Student Activities

1. Andrew Brettion, sponsored by UMN Undergraduate Research Scholarship, project title "Ice, wave, and wind simulations," 2016.
2. Ming Ma (from Tsinghua University), sponsored by Tsien Excellence in Education Program while visiting UMN, project title "Swimming model of manta ray and simulation of its fin-water interaction," 2015 – 2016.
3. Kecheng Zeng (from Tsinghua University), sponsored by Tsien Excellence in Education Program while visiting UMN, project title "Interaction between ice and waves with wind field," 2015 – 2016.
4. Luohao Wang (from Tsinghua University), sponsored by Tsien Excellence in Education Program while visiting UMN, project title "Simulation of wave and floating body interaction," 2016 – 2017.
5. Jiaqi Li (from Tsinghua University), sponsored by Tsien Excellence in Education Program while visiting UMN, project title "Interaction of gas and liquid flows with a flexible plate," 2016 – 2017.

Graduate Student Activities

Doctoral Dissertations Directed (9 in total)

Degrees from Johns Hopkins University

1. Alireza Kermani, dissertation title "Numerical study of turbulence and scalar transport process in free-surface and multi-phase flows," 2010
2. Di Yang, dissertation title "Numerical study of turbulence over various waving boundaries," 2010
3. Xin Guo, dissertation title "Numerical simulation of free surface turbulence," 2012
4. Hamid Khakpour, dissertation title "Statistics and turbulent structures of passive scalar transport in free surface flows," 2012
5. Yi Liu, dissertation title "Numerical study of strong free surface flow and breaking waves," 2013 (Degree earned from JHU after Shen had joined UMN; some supervision provided from UMN.)

Degrees from University of Minnesota

6. Adam Witt, co-advised by John Gulliver, dissertation title "Analytical and numerical investigation of an air entraining hydraulic jump," 2014
7. Antoni Calderer, co-advised by Fotis Sotiropoulos, dissertation title "Fluid-structure interaction simulation of complex floating structures and waves," 2015
8. Daniel Foti, co-advised by Fotis Sotiropoulos, dissertation title "Quantification and reduction of uncertainty of model predictions of wind turbines and plants via high-fidelity simulations," 2016

The following visiting student performed his PhD thesis study in Lian Shen's laboratory for about two years under the support of China Scholarship Council. He obtained his PhD degree from his home institute, and Lian Shen was listed in the dissertation as a co-advisor abroad.

9. Xinhua Lu (degree earned from Wuhan University), co-advised by Xiaofeng Zhang at the student's home institute, dissertation title "Large eddy simulation of fluid mud and sediment transport under waves and currents," May 2013.

Doctoral Students Advised (Current, 18 in total)

1. Qingfeng Cao, co-advised by David Pui, has passed the department doctoral qualifying exam
2. Tao Cao, has passed the department doctoral qualifying exam
3. Saurabh Chawdhary, co-advised by Fotis Sotiropoulos, thesis defended in January, 2017 and will graduate soon
4. Qiang Gao, has passed the department doctoral qualifying exam
5. Xuanting Hao, has passed the preliminary written and oral exams
6. Sida He, has passed the department doctoral qualifying exam
7. Ming Li, co-advised by Fotis Sotiropoulos, has passed the department doctoral qualifying exam
8. Tianyi Li, has passed the department doctoral qualifying exam
9. Jie Wu, has passed the department doctoral qualifying exam
10. Anqing Xuan, has passed the preliminary written and oral exams
11. Yadong Zeng, first-year PhD student

The following visiting students perform their PhD thesis studies in Lian Shen's laboratory for about two years under the support of China Scholarship Council. They will obtain their PhD degrees from their home institutes, and Lian Shen will be listed in the dissertations as the co-advisor abroad.

12. Zuo Cui (from Harbin Institute of Technology), co-advised by Hongzhou Jiang at the student's home institute.
13. Kan Kan (from Hohai University), co-advised by Yuan Zheng at the student's home institute.
14. Caixi Liu (from Shanghai University), co-advised by Yuhong Dong at the student's home institute.
15. Han Liu (from Peking University), co-advised by Zuoli Xiao at the student's home institute.
16. Pin Lyu (from Harbin Institute of Technology), co-advised by Guangyuan Wang at the student's home institute.
17. Shuai Tang (from Shanghai University), co-advised by Yuhong Dong at the student's home institute.
18. Dan Zi (from China Agricultural University), co-advised by Fujun Wang at the student's home institute.

Post-doctoral fellows supervised (6 in total)

Previously at Johns Hopkins University (2004 – 2012)

1. Dr. Di Yang, 2010 – 2012

At University of Minnesota (2012 – present)

2. Dr. Xin Guo, 2012 – 2014
3. Dr. Antoni Calderer, 2015 – 2016
4. Dr. Dionysios Angelidis (job title changed to Research Associate in June 2016; Lian Shen paid 25% of Dionysios Angelidis' salary), 2016

5. Dr. Bingqing Deng, 2014 – present
6. Dr. Zixuan Yang, 2015 – present

Visiting Scholars Hosted (4 in total)

At University of Minnesota (2012 – present)

1. Professor Yuhong Dong (from Shanghai University), 2014 – 2016
2. Assistant Professor Liang Dong (from Jiangsu University), 2015 – 2016
3. Associate Professor Weixi Huang (from Tsinghua University), 2015
4. Assistant Professor Dakui Feng (from Huazhong University of Science and Technology), 2014 – 2015

SERVICE AND PUBLIC OUTREACH

Service to the Discipline/Profession/Interdisciplinary Areas

Editorships/Journal Reviewer Experience

- Editorial board of International Journal of Computational Methods, 2015 – present
- Editorial board of Ocean Systems Engineering Journal, 2012 – present

Committee memberships

- The national committee of the American Society of Civil Engineers (ASCE) Environmental & Water Resources Institute (EWRI) on the task force of "CFD Applications in Water and Wastewater Treatment," 2015 – present

Review panels for external funding agencies, foundations, etc.

- Served on a number of panels of National Science Foundation
  Since joining UMN in 2012:
  - 3 panels in 2013
  - 1 panel in 2014
  - 1 panel in 2015
  - 2 panels in 2016
- Reviewed many proposals for National Science Foundation
- Frequently reviewed papers for journals, including: Journal of Fluid Mechanics, Physics of Fluids, Physical Review Fluids, Proceedings of the Royal Society A, Philosophical Transactions A, Journal of Computational Physics, Computers and Fluids, Journal of Turbulence, International Journal of Multiphase Flows, Environmental Fluid Mechanics, Journal of Fluid Engineering, International Journal of Heat and Fluid Flow, Journal of Hydraulic Engineering, Ocean Systems Engineering, IEEE Journal of Robotics, Applied Energy, Wind Energy, Journal of Renewable and Sustainable Energy, etc.

Organization of conferences, workshops, panels, symposia

Committee of conferences:

- Serving on the International Scientific Advisory Committee of the 4th International Workshop on

Heat Transfer (IWHT2017)

- Serving on the Scientific Advisory Committee of the 7th International Conference on Computational Mechanics (ICCM2016)
- Served on the Scientific Committee of the 2015 International Conference on Model Integration across Disparate Scales in Complex Turbulent Flow Simulation (ICMIDS)
- Served on the Scientific Advisory Committee of the 6th International Conference on Computational Mechanics (ICCM2015)
- Served on the Scientific Committee of International Conference on Ocean Systems Engineering
- Served on the Scientific Committee of International Conference on Turbulence and Interaction

Organizing mini-symposium and sessions of conferences

- Organizing the mini-symposium "CFD of turbulence for applied, industrial, or environmental flows" at the 7th International Conference on Computational Mechanics (ICCM2016)
- Organized the invited session "Coupled problems in free surface flow" at the VI International Conference on Computational Methods for Coupled Problems in Science and Engineering
- Organized the mini-symposium "Large eddy and direct numerical simulations with geophysical applications" at the 2015 US National Congress on Computational Mechanics (USNCCM)
- Organized the mini-symposium "Potential-flow and viscous-flow simulations of interfacial flows, waves and free-surface turbulence" for the 11th World Congress on Computational Mechanics and the 6th European Conference on Computational Fluid Dynamics
- Organized the mini-symposium "Advancement in numerical and physical modeling of free-surface flows" for the 8th World Congress on Computational Mechanics

Session chairs at conferences:

- Served as session chair at the International Conference on Model Integration across Disparate Scales in Complex Turbulent Flow Simulation
- Served as session chair at the International Congress of Theoretical and Applied Mechanics
- Served as session chair at the American Physical Society Division of Fluid Dynamics Annual Meetings
- Served as session chair at the ASME International Mechanical Engineering Congress and Exposition

Service to the University/College/Department

University of Minnesota

University-wide service

- Associate Director for Research, St. Anthony Falls Laboratory, 2014 – present
- Director, Eolos Wind Energy Research Consortium, 2015 – present
- Judge of poster exhibition of Minnesota Supercomputing Institute, 2016
- CSE faculty representative in University Senate for 2016 – 2019

Department/Unit Service

- Chair, Mechanical Engineering Department fellowship committee, 2013 – present
- Chair, Mechanical Engineering Department fluid mechanics teaching group, 2015 – present
- Member, Mechanical Engineering Department committee on teaching of numerical methods, 2016 – present
- Member, Mechanical Engineering Department ABET ME3332 review committee, 2016
- Member, Mechanical Engineering Department graduate fellowship committee, 2012 – 2013
- Member of a number of Mechanical Engineering qualifying exam committees, 2013 – present
- Member of a number of PhD preliminary exam committees and final defense committees, 2012 – present
- Member, St. Anthony Falls Laboratory Lorenz G. Straub Award committee, 2016 – present
- Member, St. Anthony Falls Laboratory Anderson Award nominee review committee, 2013 – present
- Member, St. Anthony Falls Laboratory Silberman Fellowship nominee review committee, 2013 – present
- Member, St. Anthony Falls Laboratory strategic planning committee, 2012 – 2015

Previously at Johns Hopkins University

University-wide service

- Center for Environmental and Applied Fluid Mechanics steering committee, 2005 – 2011
- Model Complex Systems IGERT professional development and student life committee, 2009 – 2011
- Participated in Engineering Tour & Program of JHU Office of Undergraduate Admissions, 2010

Collegiate Service

- Whiting School of Engineering curriculum committee, 2007 – 2009
- Examiner on graduate board oral examinations for more than 30 Ph.D. students. Cited by Whiting School of Engineering of JHU as a significant contributor.

Department/Unit Service

- Faculty advisor for ASCE student chapter, 2006 – 2010
- Organizer of department open house and other undergraduate recruitment efforts, 2005 – 2011
- Coordinator of department graduate seminar, 2010 – 2011
- Responsible for department course scheduling and catalog updating, 2010 – 2011