Wen-Huai Tsao, Ph.D.

Coastal Ecosystem Design Studio, Louisiana State University

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Education

Ph.D. – Civil Engineering | National Taiwan University | January 2018

Dissertation: Study on nonlinear liquid sloshing behavior and its application on tuned liquid damper by regularized boundary integral method

Advisor: Dr. Yung-Hsiang Chen and Dr. Wei-Shien Hwang

B.S. – Civil Engineering | National Taiwan University | June 2009

Expertise and Skills

Civil, Coastal, and Ocean Engineering

- Wave-structure interaction; Structural vibration control technology; Shaking table test
- Computational fluid dynamics; Water waves; Wave flume experiment
- Digital twin development; High-performance computing

Program Development

- Expertise in code development with **Fortran** and **MATLAB**
- Expertise in code development of open-source toolkit **Proteus** (**Python**)

Scientific Toolkits

- Experienced in **Fluent** (CFD), **Tecplot 360, Praview** (post-processing), **EDEM** (granular material)
- Exposure to **ETABS** (building), **SACS** (offshore), **OpenFAST** (wind turbine), **Project Chrono** (multibody)
- Linux, Mathematica, AutoCAD, LabVIEW, Microsoft Office

Professional Experience & Executed Projects

IT Consultant | 2023 – Present

Coastal Ecosystem Design Studio, Louisiana State University, USA

Project: Utilizing the sun for a sustainable future in Louisiana – a pilot solar deployment project at LSU, LSU IEI, USA (Co-PI)

Project: Anticipating threats to natural systems, ERDC US Army, USA

Project: Digital twins for agrivoltaic and floating solar farms to support design exploration, deployment, and multi-objective optimization for setting best practices, LSU IEI, USA

- Develop physical/digital twins for solving coastal ecosystem design and resilience of Louisiana areas.
- Develop high-performance computational toolkits for air/water-structure interactions and perform uncertainty quantification for solar and wind energy facilities.

Postdoctoral Researcher | 2021 – 2023

Department of Civil and Environmental Engineering, Louisiana State University, USA

Project: Coastal, marine, and riverine R&D, LSU CEE, USA

- Implemented multiphase Navier-Stokes model and potential flow model in *Proteus* to solve stability of large floating structures in waves. Tuned liquid dampers were modified to enable capability in heave control.
- Successfully accomplished the initial phase of constructing a physical wave flume.

Visiting Scholar | 2019 – 2021

Department of Civil, Architectural and Environmental Engineering, The University of Texas at Austin, USA

Project: Theoretical analysis, numerical method and model test of porous media tuned liquid damper, MOST, Taiwan (PI)

- R&D novel liquid damper utilizing porous media for floating structures and high-rise buildings.
- Successfully obtained international patents in Japan, China, and Taiwan for the developed liquid damper.
- Implemented ACI code wind load calculation.
- Developed an innovative viscous-inviscid interaction algorithm for high-resolution local sloshing simulation, resulting in a remarkable 90% reduction in computational costs.

Postdoctoral Research Fellow | 2018 – 2019

Department of Bioenvironmental Systems Engineering / Civil Engineering, National Taiwan University, Taiwan

Project: R&D and experimental verification of nonlinear tuned mass dampers, MOST, Taiwan

- Directed a research team in the generation of nonlinear track-TMD design, examination of specimen fabrication, and conducting large-scale shaking-table experiments within a two-month timeframe.
- Applied ACI code seismic evaluation.
- Successfully initiated a new project involving the coupling of CFD-DEM for simulating full-scale riverine levee breaches.

Research Assistant | 2014 – 2018

Department of Engineering Science and Ocean Engineering, National Taiwan University, Taiwan

Project: Numerical studies on wakes of a three-dimensional airfoil, MOST, Taiwan

- Enhanced numerical skills to minimize significant errors on the trailing edge of 2D/3D airfoils and propellers.
- Achieved lower numerical cost in accurately locating the position of the wake center line.

Project: Nonlinear sloshing analysis by regularized boundary integral methods, MOST, Taiwan

- Created an innovative Boundary Integral Method that significantly improved numerical accuracy and stability in solving potential flows, resulting in an impressive efficiency gain of 86%.
- Characterized nonlinear sloshing behavior and applied API 650 code for sloshing evaluation.

Journal Articles

1. **Tsao, W.H.,** Kees, C.E., Tovar, E. (2023). Advances in high-order computational models for accurate simulation of non-hydrostatic wave characteristics under significant topography effect, *Journal of Waterway Port Coastal and Ocean Engineering*, (In Preparation).

2. **Tsao, W.H.,** Huang, W.C., Huang, Y.L., Hwang, W.S. (2023). Optimization of porous-media tuned liquid dampers for enhancing structural vibration control during seismic events, *Earthquake Engineering & Structural Dynamics*, (In Preparation).

3. **Tsao, W.H.,** Kees, C.E., Schurr, R. (2023). High-order phase-resolving CutFEM for wave transformation over natural shorelines, *Journal of Ocean, Offshore and Arctic Engineering*, (Under review).

4. **Tsao, W.H.,** Kees, C.E. (2023). An arbitrary Lagrangian-Eulerian regularized boundary integral method for nonlinear free-surface flows over complex topography and wave-structure interaction, *Engineering Analysis with Boundary Elements*, 157, 326-341.

5. **Tsao, W.H.,** Chen, Y.C., Kees, C.E., Manuel, L. (2023). Response mitigation of floating platform by porous-media-tuned liquid dampers, *Journal of Ocean, Offshore and Arctic Engineering*, 145(5), 051203.

6. **Tsao, W.H.,** Chen, Y.C., Kees, C.E., Manuel, L. (2022). The effect of porous media on wave-induced sloshing in a floating tank, *Applied Sciences,* 12(11), 5587.

7. **Tsao, W.H.,** Huang, L.H. and Hwang, W.S. (2021). An equivalent mechanical model with nonlinear damping for sloshing rectangular tank with porous media. *Ocean Engineering*, 242, 110145.

8. **Tsao, W.H.** and Kinnas, S.A. (2021). Local simulation of sloshing jet in a rolling tank by viscous-inviscid interaction method. *Results in Engineering*, 11, 100270.

9. **Tsao, W.H.** and Huang, Y.L. (2021). Sloshing force in a rectangular tank with porous media. *Results in*

Engineering, 11, 100250.

10. **Tsao, W.H.** and Chang, T.J. (2020). Sloshing phenomenon in rectangular and cylindrical tanks filled with porous media: supplementary solution and impulsive-excitation experiment. *Journal of Engineering Mechanics*, 146(12), 04020139.

11. **Tsao, W.H.** and Hwang, W.S. (2019). Dynamic characteristics of liquid sloshing in cylindrical tanks filled with porous media. *IOP Conference series: Earth and Environmental Science*, 351, 012007.

12. **Tsao, W.H.** and Hwang, W.S. (2018). Tuned liquid dampers with porous media. *Ocean Engineering*, 167(1), 55-64.

13. Chen, Y.H., Hwang, W.S. and **Tsao, W.H.** (2018). Nonlinear dynamic characteristics of rectangular and cylindrical TLD's. *Journal of Engineering Mechanics*, 144(9), 06018004.

14. **Tsao, W.H.** and Hwang, W.S. (2017). Regularized boundary integral methods for three–dimensional potential flows. *Engineering Analysis with Boundary Elements*, 77, 49-60.

15. Chen, Y.H., Hwang, W.S. and **Tsao, W.H.** (2017). Nonlinear sloshing analysis by regularized boundary integral method. *Journal of Engineering Mechanics*, 143(8), 040170046.

Conference Proceedings

1. **Tsao, W.H.**, Schurr, R., Kees, C.E. (2023). High-order phase-resolving method for wave transformation over natural shorelines, *Proceedings of the ASME 2023 42nd International Conference on Ocean, Offshore and Arctic Engineering*, Melbourne, Australia.

2. **Tsao, W.H.**, Chen, Y.C., Kees, C.E., Manuel, L. (2022). Response mitigation of floating platform by porous-media tuned liquid dampers, *Proceedings of the ASME 2022 41st International Conference on Ocean, Offshore and Arctic Engineering*, Hamburg, Germany.

3. **Tsao, W.H.** and Kinnas, A.S. (2020). Local study of jet of a fluid sloshing inside a rolling tank. *Proceedings of the ASME 39th International Conference on Ocean, Offshore and Arctic Engineering*, Fort Lauderdale, USA.

4. **Tsao, W.H.** and Kinnas, A.S. (2020). Numerical simulation of fluid sloshing in a rolling tank. *25th SNAME Offshore Symposium*, Houston, USA.

5. **Tsao, W.H.** (2019). Dynamic characteristics of liquid sloshing in cylindrical tanks filled with porous media. *International Conference on Advances in Civil and Ecological Engineering Research*, Kaohsiung, Taiwan.

6. **Tsao, W.H.** and Chang, C.M. (2018). New numerical integration method for dynamic systems with high nonlinearity. *The 14th National Conference on Structural Engineering/The 4th National Conference on Earthquake Engineering*, Taichung, Taiwan.

7. **Tsao, W.H.** and Hwang, W.S. (2018). Study on nonlinear sloshing problem. *30th Taiwan SNAME and MOST Symposium*, Taipei, Taiwan.

8. **Tsao, W.H.** (2018). Analysis on porous-media tuned liquid damper for vibrational control in flexible structures. *Proceedings of the 40th Ocean Engineering Conference*, Kaohsiung, Taiwan.

9. **Tsao, W.H.** and Hwang, W.S. (2017). The analysis of regularized boundary integral methods for a non-smooth body in potential flows. *29th Taiwan SNAME and MOST Symposium*, Taipei, Taiwan.

10. **Tsao, W.H.** and Hwang, W.S. (2016). The analysis of regularized boundary integral methods for an oblate body in potential flows. *28th Taiwan SNAME and MOST Symposium*, Taipei, Taiwan.

Posters and Abstracts

1. **Tsao, W.H.** and Kees, C.E. (2023). Computational analysis of wave and current interactions with mangrove forests. *American Geophysical Union Fall Meeting*, San Francisco, USA.

2. Kees, C.E., Schurr, R., **Tsao, W.H.** (2023). Higher-order methods for phase-resolving wave/structure interaction,

SIAM Conference on Mathematical and Computational Issues in the Geosciences, Bergen, Norway.

3. **Tsao, W.H.**, Chen, Y.C., Kees, C.E., Manuel, L. (2023). Global motions of a floating platform with tuned liquid damper in waves. *Engineering Mechanics Institute Conference*, Atlanta, USA.

4. **Tsao, W.H.** and Kees, C.E. (2023). *Proteus*: High-order methods for wave-structure interactions in coastal and offshore environments. *Scientific Computing Around Louisiana*, New Orleans, USA.

5. **Tsao, W.H.** and Kees, C.E. (2022). An improved boundary integral equation method with arbitrary Lagrangian-Eulerian approach for nonlinear wave-bottom interaction problems. *American Geophysical Union Fall Meeting*, Chicago, USA.

6. Kees, C.E., **Tsao, W.H.**, and Schurr, R. (2022). Higher-order methods for phase-resolving wave/structure interaction, *5th Annual Meeting of the SIAM Texas-Louisiana Section*, Houston, USA.

7. **Tsao, W.H.** and Kees, C.E. (2022). Arbitrary Lagrangian-Eulerian method in finite-element model for nonlinear wave-bottom interaction, *8th Young Coastal Scientists and Engineers Conference-Americas*, Pensacola, USA.

8. Kees, C.E., Tovar, E., Schurr, R., and **Tsao, W.H.** (2021). High-performance computational models of non-hydrostatic water waves over complex bathymetry. *American Geophysical Union Fall Meeting*, New Orleans, USA.

Patents

1. **Wen-Huai Tsao** and Wei-Shien Hwang. "*Tuned Liquid Dampers with Porous Media*," Japan Patent #3217982, issued August 22, 2018.

2. **Wen-Huai Tsao** and Wei-Shien Hwang. "*Tuned Liquid Dampers with Porous Media*," China Patent #ZL20182 0503987.2, issued January 18, 2019.

3. **Wen-Huai Tsao** and Wei-Shien Hwang. "*Tuned Liquid Dampers with Porous Media*," Taiwan Patent #M564058, issued July 21, 2018.

Academic Service

Invited Talks
- Civil and Environmental Engineering Seminar, LSU in September 2022
- *Proteus* Workshop, LSU Center for River Studies in July 2021
- Ocean Engineering Group Seminar, UT Austin in June 2021, January 2021, June 2020, January 2020
- Environmental and Water Resources Engineering Group Seminar, UT Austin in September 2020, February 2020

Journal Reviewers
- Mechanical Systems and Signal Processing; Structures; Engineering Computations; International Journal of Structural Stability and Dynamics, Applied Sciences; Ocean Engineering; China Ocean Engineering; Marine Pollution Bulletin; Aerospace Science and Technology

Professional Organizations
- Member of ASCE EMI Fluid Dynamics Committee

Teaching Tendency

Undergraduate Courses

Structural theory; Fluid mechanics; Ocean engineering; FE exam exercise; Programming boot camp

Graduate Courses

Dynamics of structures; Structural control theory; Computational methods for potential flows

Teaching Experience

Guest Lecturer | CE2200 Fluid Mechanics | fall 2023

  Department of Civil and Environmental Engineering, Louisiana State University

  ▪ Lecture 3 courses on the introduction of fluid mechanics, fluid kinematics, and dynamics

Guest Lecturer | Software Carpentry | summer 2022, summer 2023

  Department of Civil and Environmental Engineering, Louisiana State University

  ▪ Lecture 2 courses on Automatic Tasking with Unix Shell, Programming with Python, Version Control with Git

Guest Lecturer | CE7700 Computational Methods for Coastal and Riverine Mechanics | spring 2022, spring 2023

  Department of Civil and Environmental Engineering, Louisiana State University

  ▪ Lecture 2 courses on boundary element method for potential flows

Guest Lecturer | CE7430 Structural Design for Dynamic Loads | spring 2022

  Department of Civil and Environmental Engineering, Louisiana State University

  ▪ Lecture 1 course on passive structural control theory: tuned mass damper and tuned liquid damper

Guest Lecturer | CIE1013 Applied Mechanics | spring 2018

  Department of Civil Engineering, National Taiwan University

  ▪ Lecture 2 courses on statics, including dry friction force on flat belts, wedges, pivots, etc.

Teaching Assistant | CIE5058 Railway Engineering | spring 2011, spring 2013

  Department of Civil Engineering, National Taiwan University

  ▪ Introduce fundamentals of railway dynamics and host weekly office hours

Teaching Assistant | ESOE5045 Dynamics of Structures | fall 2010, fall 2011

  Department of Engineering Science and Ocean Engineering, National Taiwan University

  ▪ Host weekly office hours and topic review sessions

Honors & Awards

▪ Southeastern Conference Emerging Scholar, Louisiana State University, USA, 2021

▪ Postdoctoral Research Abroad Scholar, Ministry of Science and Technology, Taiwan, 2019

Additional Information

Employment Eligibility: EB2-NIW approved, PR adjustment in progress, EAD issued

FE exam passed

Languages: Mandarin Chinese (native), English (fluent)

YMCA basketball volunteer coach

References

Christopher E. Kees | CSRS Distinguished Professor | Principal Investigator

  Department of Civil and Environmental Engineering, Louisiana State University

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Lance Manuel | Professor | Collaborator

  Department of Civil, Architectural and Environmental Engineering, The University of Texas at Austin

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Wei-Shien Hwang | Professor | Dissertation Advisor

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