Wen-Huai Tsao, Ph.D.

Department of Civil and Environmental Engineering, 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; Vibration control technology; Shaking table test
- Computational fluid dynamics; Water waves; Wave flume experiment
- High-performance computing

Program Development

- Experience on code development with **Fortran** and **MATLAB**
- Experience on code development of open-source computational toolkit **Proteus** (**Python**)

Scientific Toolkits

- Experience on **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

Postdoctoral Researcher | 2021 – Present

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

Project: *Proteus*: coastal, marine, and riverine R&D for Anticipating Threats to Natural Systems program

- Link models across a range of resolutions and physical process representations to achieve the accuracy required for coastal ecosystem designs
- Develop high-performance CFD toolkit *Proteus* for multiphase Navier-Stokes and potential flow models for free-surface waves and wave-structure interaction simulations

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

- R&D and experimental verification of a new tuned liquid damper with porous media for floating structures and high-rise buildings; International patents in Japan, China, and Taiwan are obtained; **ACI code for wind loads** is applied
- Develop a new viscous-inviscid interaction algorithm for high-resolution local sloshing simulation. Superior efficiency is gained

Postdoctoral Research Fellow | 2018 – 2019

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

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

- Design nonlinear track-TMD systems to resist seismic and blast loads; Lead a team to conduct large-scale shaking-table experiments; **ACI code for seismic evaluation** is applied

- Deliver full-scale simulation for fracture of riverine levee breach in flood by coupling CFD-DEM algorithm

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

- Locate the position of the wake center line of an airfoil or propeller in the potential theory

Project: Nonlinear sloshing analysis by regularized boundary Integral methods

- Characterize nonlinear sloshing behavior and its application on TLD for structural vibration control; **API code for sloshing evaluation** is applied
- Develop new BEM for solving potential flows. Numerical accuracy, stability, and efficiency are improved

Journal Articles

1. **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*, (Under Review).

2. **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*, (Accepted).

3. **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.

4. **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.

5. **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.

6. **Tsao, W.H.** and Huang, Y.L. (2021). Sloshing force in a rectangular tank with porous media. *Results in Engineering*, 11, 100250.

7. **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.

8. **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.

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

10. 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.

11. **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.

12. 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.**, 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.

2. **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.

3. **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.

4. 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.

5. **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.

6. 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
- Ocean Engineering; China Ocean Engineering; Marine Pollution Bulletin

Teaching Tendency

Undergraduate Courses

Structural theory; Fluid mechanics; Ocean engineering

Graduate Courses

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

Teaching Experience

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 | CE7700 Computational Methods for Coastal and Riverine Mechanics | spring 2022

Department of Civil and Environmental Engineering, Louisiana State University

- Lecture 2 courses on boundary element method for potential flows

Guest Lecturer | CIE1013 Applied Mechanics | spring 2018

Department of Civil Engineering, National Taiwan University

- Lecture 2 courses on statics includes dry friction force on flat belt, wedge, pivot, 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

Citizenship: Taiwan

FE exam passed

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

YMCA basketball volunteer coach

References

Christopher E. Kees | CSRS Distinguished Professor | Principal investigator

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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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