Heng ZHU

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EDUCATION

Chalmers University of Technology, Gothenburg, Sweden

- ***Ph.D.*** *in Shipping and Marine Technology* (Mar. 2021 – Expected Dec. 2024)
  - Dissertation: Fluid-Structure Interaction Analysis of Wingsails with a Crescent-Shaped Profile.
  - Licentiate Thesis: Methods for the Evaluation of Wingsails with a Crescent-Shaped Profile (Degreed obtained in May 2023)
  - Main supervisor: Prof. Hua-Dong Yao; Examiner: Prof. Jonas W. Ringsberg
- ***M.Sc.*** *in Naval Architecture and Ocean Engineering* (Aug. 2018 – Oct. 2020)
  - Thesis: CFD Investigation of Wind-Powered Ships under Extreme Condition: Simulations on the NACA-0015 Foil under Deep Stall Condition
  - Main supervisor: Prof. Rickard E. Bensow

Shanghai Jiao Tong University, Shanghai, China

- ***B.Eng.*** *in Naval Architecture and Ocean Engineering* **(**Sept. 2014 – Jul. 2018**)**
  - Thesis: Multi-Objective Collaborative Optimization of Ship Lines Plans Based on Seakeeping and Resistance Performance
  - Main supervisor: Prof. Ning Ma

RESEARCH EXPERIENCE

Chalmers University of Technology, Gothenburg, Sweden

- *Ph.D. Researcher* (Mar. 2021 – Dec. 2024)

  Project: Fluid-Structure Interaction Analysis Applied to Wind-Assisted Ship Propulsion.
  - Generated a telescopic wingsail concept design with a crescent-shaped sectional profile to enhance aerodynamic efficiency.
  - Established comprehensive numerical models utilizing CFD (URANS, LES, and DES) to predict wind loads, investigate unsteady flow characteristics, and analyze interactions among multiple sails.
  - Conducted wind tunnel tests to validate the numerical model and reveal model-scale effects of wingsails.
  - Developed and compared several structural designs of wingsails by performing structural analysis using FEA.
  - Developed two-way coupled FSI methods combining CFD and FEA to assess the structural response and its influence on the aerodynamic performance.
  - Utilized an in-house program, ShipCLEAN, to predict the propulsive performance of wingsails, propose operation strategies, and estimate long-term fuel savings.

- Collaborated effectively with industry partners, ScandiNAOS AB and Stena Rederi AB, to apply research findings in practical settings.

- *Master Thesis Student* (Jan. 2020 – Oct. 2020)
  Project: CFD investigation of wind-powered ships under extreme conditions.
  - Performed two- and three-dimensional CFD simulations based on DES methods in OpenFOAM to evaluate the performance of rigid wingsails under deep stall conditions.
  - Conducted detailed verification studies including mesh independence and discretization scheme comparison.
  - Cooperated with SSPA Sweden AB.
- *Project Student* (Aug. 2019 – Dec. 2019)
  - Designed a high-speed passenger ferry tailored for the Gothenburg archipelago, delivering optimized ship hydromechanics calculations (stability assessment, calm water resistance, hull optimization, propeller design, and seakeeping analysis) and a refined hull lines plan.
  - Cooperated with Styrsöbolaget and Volvo Penta.

Second Institute of Oceanography, MNR of China, Hangzhou, China

- *Lab Intern* (Jul. 2017 – Aug. 2017)
  - Conducted hydrographic tests to assess suspended substances, particle size distribution, and salinity in water samples.

Shanghai Jiao Tong University, Shanghai, China

- *Bachelor Thesis Student* (Dec. 2017 – Jun. 2018)
  Project: Multi-Objective Collaborative Optimization of Ship Lines Plans Based on Seakeeping and Resistance Performance
  - Optimized the hull design of a high-speed fisher based on its rolling amplitude and wave-making resistance.
  - Developed a reforming program in Fortran. Established a multi-objective collaborative optimization procedure by applying the NSGA-II algorithm.
- *Project Student* (Oct. 2015 – Mar. 2017)
  Participated in several research and design projects including:
  - Project 1: Design of a 78400 DWT bulk carrier.
  - Project 2: Dynamic study of ship launching with airbags, based on Bonjean Curves.
  - Project 3: Model testing of a turret mooring FPSO system under various wave conditions.
  - Project 4: Design, model making, and tests of a ground-effect landing craft.
  - Project 5: Dynamic stress analysis of an armchair design for shipboard use.

TEACHING & SUPERVISION EXPERIENCE

Chalmers University of Technology, Gothenburg, Sweden

*Total teaching and supervision hours: Approximately **730** hours.*

- **Master Thesis Supervisor**
  Supervised two master thesis projects, providing guidance through the research process, including

problem formulation, methodology, data analysis, and thesis writing.

- Sreeharsha Bikkireddy, *Structural Analysis of Telescopic Wing Sails for Wind-Assisted Ship Propulsion*, (Jan. 2022 – Dec. 2022)
- Erik Ljungberg, *Evaluation of Novel Wingsail Concepts in Terms of Aerodynamic Efficiency*, (Jan. 2023 – Oct. 2023)

- **Contributions to Master-Level Courses**
  - *Lecturer*, MMS185 Stability and Design Basis for Marine Structures (annually, 2021 – 2024)
    Developed and delivered around 25% of lectures of the entire course, focusing on ship design principles, 3D CAD in naval architecture, and practical ship hydrostatic assessment.
  - *Guest Lecturer & Project Supervisor***,** TRA270 Engineering Fluid-Structure Interaction: Technologies and Practices (annually, 2022 – 2023)
    Delivered guest lectures regarding FSI application in wind-assisted ship propulsion and supervised five projects per year, regarding numerical FSI simulations for engineering applications.
  - *Tutor & Teaching Assistant*, SJO747 Wave Loads and Seakeeping (2023)
    Delivered tutorials regarding wave theory and seakeeping and guided students to conduct practical seakeeping assessments by using ABB OCTOPUS.
- **Contributions to Bachelor-Level Course**
  - *Teaching Assistant*, TME136 Programming and Algorithmic Thinking (2021)
    Guided students to learn programming in MATLAB.

Shanghai Jiao Tong University, Shanghai, China

- **Model-Making Tutor** (2016 & 2017)
  - Guided summer camp students in ship model making and testing.

PUBLICATIONS & CONFERENCE CONTRIBUTIONS

Journal Articles:

- **Zhu, H.***, Yao, H. -D., Thies, F., Ringsberg, J. W., & Ramne, B. (2023). Propulsive performance of a rigid wingsail with crescent-shaped profiles. *Ocean Engineering*, *285*, 115349. https://doi.org/10.1016/j.oceaneng.2023.115349. (SJR Q1 in Ocean Engineering, IF 5.0)
- **Zhu, H.***, Yao, H.-D., & Ringsberg, J. W. (2024). Unsteady RANS and IDDES studies on a telescopic crescent-shaped wingsail. *Ships and Offshore Structures*, 1-14. https://doi.org/10.1080/17445302.2023.2256601. (SJR Q2 in Ocean Engineering, IF 2.1)

Conference Proceedings:

- **Zhu, H.***, Nikmanesh, M. B., Yao, H. -D., Ramne, B., & Ringsberg, J. W. (2022). Propulsive performance of a novel crescent-shaped wind sail analyzed with unsteady RANS. *Proceedings of the ASME 2022 41st International Conference on Ocean, Offshore and Arctic Engineering (OMAE 2022), June 5 – 10, Hamburg, Germany* (Vol. 85925, p. V007T08A053). http://dx.doi.org/10.1115/OMAE2022-79867.
- **Zhu, H.***, Yao, H.-D., & Ringsberg, J. W. (2022). Unsteady RANS and IDDES study on a telescopic crescent-shaped windsail. *Proceedings of the 7th International Conference on Ships and Offshore Structures (ICSOS 2022), October 17 – 19, Ålesund, Norway.*

- **Zhu, H.***, Bikkireddy, S., Ringsberg, J. W., Yao, H.-D., & Ramne, B. (2023). Structure analysis of lightweight sail structures for wind-assisted ship propulsion. In J. W. Ringsberg & C. Guedes Soares (Eds.), *Advances in the Analysis and Design of Marine Structures: Proceedings of 9th International Conference on Marine Structures (MARSTRUCT 2023, 3 – 5 April 2023, Gothenburg, Sweden)* (pp. 327–335). CRC Press. http://dx.doi.org/10.1201/9781003399759-36.
- **Zhu, H.**, Chernoray, V., Ringsberg, J. W., Yao, H.-D.*, & Ramne, B. (2023). Experimental study on structure responses of triple wing sails to turbulence flows at multiple apparent wind angles. In J. W. Ringsberg & C. Guedes Soares (Eds.), *Advances in the Analysis and Design of Marine Structures: Proceedings of 9th International Conference on Marine Structures (MARSTRUCT 2023, 3 – 5 April 2023, Gothenburg, Sweden)* (pp. 781–787). CRC Press. http://dx.doi.org/10.1201/9781003399759-86.
- **Zhu, H.**, Thies, F.*, Ringsberg, J. W., & Ramne, B. (2023). Development and performance analysis of a crescent-type sail for WASP applications. *Proceedings of the International Academic Conference on Shipping, Sustainability & Solutions 2023 (SSS 2023), March 2 – 3, Hamburg, Germany.*
- **Zhu, H.***, Chernoray, V., Ringsberg, J. W., Yao, H.-D., & Ramne, B. (2024). Fluid-structure interaction analysis of crescent-shaped wingsails. *Proceedings of the ASME 2024 43rd International Conference on Ocean, Offshore and Arctic Engineering (OMAE 2024), June 9 – 14, Singapore, Singapore. Accepted.*

Theses:

- **Zhu, H.** (2020). *CFD Investigation of Wind-Powered Ships under Extreme Condition: Simulations on the NACA-0015 Foil under Deep Stall Condition.* [Thesis for the degree of Master of Science, Chalmers University of Technology]. Gothenburg, Sweden. *Available at* https://odr.chalmers.se/handle/20.500.12380/301919.
- **Zhu, H**. (2023). *Methods for the Evaluation of Wingsails with a Crescent-Shaped Profile.* [Thesis for the degree of Licentiate of Engineering, Chalmers University of Technology]. Gothenburg, Sweden. *Available at* https://research.chalmers.se/en/publication/535462.

Manuscripts of Journal Articles:

- **Zhu, H.***, Chernoray, V., Ringsberg, J. W., Ramne, B., & Yao, H.-D. Experimental study on aerodynamic loads and structural responses of crescent-shaped wingsails. *Under reviewer by Physics of Fluids.* (SJR Q1 in Condensed Matter Physics, IF 4.6)
- **Zhu, H.***, Yao, H.-D., & Ringsberg, J. W. Unsteady RANS CFD studies on an aeroelastic foil. *In manuscript, to be submitted to Physics of Fluids.*
- Pradhan, P., Yao, H.-D.*, Joshi, V., **Zhu, H.**, Ringsberg, J. W., & Zhao, X. Actively controlled propulsion of lined-up triple foils with flapping motions. *In manuscript, to be submitted to Physics of Fluids.*
- **Zhu, H.***, Chernoray, V., Ringsberg, J. W., Ramne, B, Shao, Y., & Yao, H.-D. Model-scale effect analysis of a crescent-shaped wingsail. *In manuscript, to be submitted to Physics of Fluids.*
- **Zhu, H.***, Chernoray, V., Ringsberg, J. W., Ramne, B., Shao, Y., & Yao, H.-D. Fluid-structure interaction analysis of crescent-shaped wingsails. *In manuscript, to be submitted to Ocean Engineering.*
- Xu, K., Ljungberg, E., van Reen, S., **Zhu, H.***, & Yao, H.-D. Parametric Evaluation of Two- and Three-element Wingsail Concepts in Terms of Aerodynamic Efficiency. *In manuscript, to be submitted to Ocean Engineering.*

Other Conference Contributions:

- **Zhu, H.***. (2021). "The WindStruc project - sailing ships. " *1st International Webinar 2021 on Methods, Models and Simulations of Hydrodynamic and Aerodynamic Problems. June 16, Gothenburg, Sweden.* Oral presentation.

- **Zhu, H.***, Yao, H.-D., Janson, C.-E., & Ringsberg, J. W. (2022). "Fluid-structure interaction analysis for wind-assisted ship propulsion: aeroelastic simulations for NACA 23024 foil." *DNV Nordic Maritime University Workshop 2022. March 30 – April 1, Horten, Norway.* Oral presentation.
- **Zhu, H.***, Yao, H.-D., Janson, C.-E., & Ringsberg, J. W. (2022). "Aeroelastic studies for NACA 23024 foil based on unsteady RANS CFD simulations. " *4th Workshop on Scientific Computing in Sweden (SwedComp22). October 26, Gothenburg, Sweden.* Poster.
- **Zhu, H.***, Yao, H. D., Ramne, B., Ringsberg, J. W., & Thies, F. (2023). "Design, development and performance evaluation of wind-assisted ship propulsion systems. " *10th Annual World Congress of Ocean-2023 (WCO-2023). January 9 – 11, Sapporo, Japan.* Oral presentation.
- **Zhu, H.***, Yao, H. D., Ramne, B., Ringsberg, J. W., & Thies, F. (2023). "Development and performance analysis of a crescent-type wingsail for WASP applications. " *DNV Nordic Maritime University Workshop 2023. January 26 – 27, Gothenburg, Sweden.* Oral presentation.
- **Zhu, H.***, Yao, H. D., Ringsberg, J. W., Thies, F., & Ramne, B. (2024). "Aerodynamic performance and fluid-structure interaction of cambered wingsails. " *DNV Nordic Maritime University Workshop 2024. January 25 – 26, Espoo, Finland.* Oral presentation.

SCHOLARSHIPS & FUNDINGS

- **Hugo Heyman Fund** (2024): Granted 36,175 SEK.
- **Chalmers Research Fund** (2022): Granted 35,000 SEK.
- **Adlerbertska Foreign Student Hospitality Foundation Scholarship** (2021 – 2023): Received approximately 6,000 SEK annually over three years.
- **Avancez Scholarships** (2018 & 2019): Granted a 75% tuition fee reduction for two academic years, 210,000 SEK in total.
- **Annual Merit Scholarship, China Classification Society** (2015): Awarded 3,000 CNY for academic excellence.

AWARDS & HONORS

- The 2nd Prize, Pei-yuan Chou Mechanics Contest of Shanghai City, 2017.
- The Prize for Excellence, Pei-yuan Chou Mechanics Contest of China, 2017.
- The 3rd Prize, Pei-yuan Chou Mechanics Contest of Shanghai City, 2016.
- Outstanding Individual in Summer Social Practice of Shanghai Jiao Tong University, 2015 & 2016.

PROFESSIONAL SERVICES

- **Journal Reviewer**: Actively participated as a peer reviewer:
  - *Ocean Engineering* (5 reviews)
  - *Ships and Offshore Structures* (2 reviews)
- **Associate Member** (May 2022 – Now), The Royal Institution of Naval Architects (RINA), UK: Engage with a network of professionals in naval architecture to exchange knowledge and promote best practices in the field.
- **Member** (Sept. 2018 – Oct. 2020), Chalmers Naval Architecture Students' Society, Sweden:

Participated in educational and professional development activities within the society, fostering a collaborative environment among students.

- **President** (Jun. 2016 – May 2017) and **Member** (Sept. 2014 – May 2017), Ocean Association of Shanghai Jiao Tong University, China: Led the organization in enhancing student engagement and promoting maritime education through various initiatives and events.

SKILLS

- **Naval Architecture**: Ship design and hull optimization; hydrostatic assessments; resistance prediction; seakeeping analysis.
- **Computational Fluid Dynamics (CFD)**: Incompressible turbulent flow simulations (URANS, LES, and DES); laminar-turbulent transition analysis; flow around bluff bodies (flow separation and reattachment); aeroelastic simulations.
- **Finite Element Analysis (FEA) and Fluid-Structure Interaction (FSI)**: Thin-walled structures and nonlinear FEA; one- and two-way coupled FSI.
- **Experimental Fluid Dynamics (EFD)**: Wind tunnel tests for aerodynamic and aeroelastic studies.
- **Language Proficiency**: Fluent in English (C1 Level), native proficiency in Chinese.

OTHER EXPERIENCE

- **Board Member** (Jun. 2023 – Present): Chalmers Doctoral Students Guild (DS)
  - Ph.D. student representative of Department of Mechanics and Maritime Sciences.
  - Committee member and interviewer of the 2024 Chalmers Supervisor of The Year Award.
  - Committee member of the 2023 Chalmers Research Fund.
- **Assistant Local Organizer** (Apr. 2023): 9th International Conference on Marine Structures (MARSTRUCT)
  - Assisted in IT support during the conference sessions.
- **Volunteer Sub-leader** (Oct. 2014 – Jun. 2016): Voluntary Center at Shanghai Jiao Tong University
  - Planned and organized more than 10 voluntary activities.
  - Served as an interpreter of Ba Jin's former residence for one year.

PERSONAL INTERESTS & HOBBIES

Paleontology, cartography, science fiction.