# Zhengru Ren


Email: zhengru.ren@ntnu.no, renzhengru@gmail.com
Mobile: +47 474 42 832
URL: https://www.zhengru.ren
ORCID: 0000-0001-5522-8094
Address: O. Nielsens Veg 10, Tyholt, N-7491 Trondheim, Norway


## Work experience

2019.8 – Present **Postdoctoral researcher**, Department of Marine Technology — Trondheim, Norway
Norwegian University of Science and Technology (NTNU)
Centre for Research-based Innovation of Marine Operations (SFI MOVE)
- Topic: Onboard decision support and digitization in intelligent marine operations
(Sea state estimation, model auto-tuning, and wave prediction based on vessel responses)

2016.4 – 2019.8 **Researcher**, Department of Oceans Operations and Civil Engineering — Ålesund, Norway
Norwegian University of Science and Technology
- Topic: Simulation and control of floating wind turbine installation

## Education

2016.1 – 2019.8 **Ph.D.**, Department of Marine Technology — Trondheim, Norway
Norwegian University of Science and Technology
Centre for Research-based Innovation of Marine Operations (SFI MOVE)
Centre for Autonomous Marine Operations and Systems (NTNU AMOS)
- Thesis: Advanced control algorithms to support automated offshore wind turbine installation
- Main supervisor: Roger Skjetne, Co-supervisor: Zhen Gao

2013.8 – 2015.6 **MSc.** in Marine Technology (Specialization in Marine Cybernetics) — Trondheim, Norway
Norwegian University of Science and Technology
- Thesis: Fault-tolerant control of thruster-assisted position mooring system
- Supervisor: Roger Skjetne

2008.9 – 2012.6 **B.Eng.** in Ocean Engineering, Dalian University of Technology — Dalian, China
- Thesis: The schematic design of a 19000DWT production oil tanker

## Research interests

Nonlinear control theory; sensor fusion; marine operation; offshore installation; sea state estimation; offshore wind turbine; renewable energy; dynamic positioning (DP) system; thruster-assisted position mooring (TAPM) system; underwater robots; fault diagnosis; multi-agent system; model tuning; digitalization.

## Teaching experience

**MR8500 - PhD Topics in Marine Control Systems, NTNU, 2020**

Lectures: Backstepping design on complex nonlinear systems. [Link: Slides 1, 2]

## Teaching plan

I plan to teach the following courses relevant to robotics at both undergraduate and graduate levels:

* Modeling and simulation of physical processes,
* Filtering and sensor fusion,
* Linear and nonlinear control theories.

The theories and applications to mechanical systems (such as robotics, marine vessels, and airplanes) will be introduced. State-of-the-art research outcomes will be involved into the courses and student projects. The courses can be flexibly adjusted according to the department's education plan.

## Supervision experience

**Co-supervision of PhD student at NTNU**

Behfar Ataei, 2019.8–2022.6, Virtual prototyping of installation of offshore power systems.

**Co-supervision of master students at NTNU**

Sindre Sagsveen Slåttum, 2020.8–2021.6, Load and sea state estimation based on distributed IMUs.

Yuxuan Cai, 2020.8–2021.6, Data-driven condition monitoring of marine battery energy storage systems.

Jens Nikolai Alfsen, 2019.8–2020.6, Dynamic optimal path-planning for autonomous harbor maneuvering.

Caroline Sophie Røhm Fleischer, 2019.8–2020.6, Optimal path-planning on a bio-inspired neural network landscape model for autonomous surface vessels.

Hongyu Zhou, 2019.8–2020.6, Autonomous guidance, stepwise path planning, and path-following control with anti-collision for autonomous marine robots.

Elias Gauslaa, 2019.8–2020.6, Navigation, guidance, and control for autonomous autodocking of ships.

Jakob Stensvik Jensen, 2019.8–2020.6, Dynamic optimal path-planning for autonomous harbor maneuvering.

Baiheng Wu, 2018.4–2019.1, Image processing and target tracking technology in the sea cucumber fishing application.

## Academic experience

**Participation research projects**

**Norwegian Centre of Research-based Innovation SFI MOVE (Marine Operations in Virtual Environments)**

2016-2019 Project 5: Innovative installation of wind power systems

2019-2021 Project 6: Onboard decision tool

**Norwegian Centre of Excellence, NTNU AMOS (Centre for Autonomous Marine Operations and Systems)**

2016-2019 Project 3: Risk management and maximized operability of ships and ocean structures

**Centre for Research-based Innovation SFI SAMCoT (Sustainable Arctic Marine and Coastal Technology)**

2019 Numerical simulations of moored floating structures in ice

### Funding/grants

Open Project of the State Key Laboratory of Ocean Engineering, Shanghai Jiao Tong University

2017 – 2020 Research and development of innovative offshore wind farm installation techniques, second applicant

Open Project of the State Key Laboratory of Coastal and Offshore Engineering, Dalian University of Technology

2018 – 2020 The structural influence of passive damper to offshore wind turbine, second applicant

Norwegian Ship Owner's Association's Fund, 2016, 2020

## Publications

### Journal papers

[1] **Zhengru Ren**$^*$ and Roger Skjetne. A survey of backstepping control design to ODE systems. *Automatica*, 2021. Under review, [Q1,IF:6.583].

[2] **Zhengru Ren**, Xu Han, Xingji Yu$^*$, Roger Skjetne, Bernt Johan Leira, Sævik, and Man Zhu. Data-driven identification of 6DOF dynamic model and wave load estimation for a ship in waves. *Mechanical Systems and Signal Processing*, 2020. Under review, [Q1,IF:6.471].

[3] **Zhengru Ren**, Amrit Shankar Verma, Ye Li$^*$, Julie J.E. Teuwen, and Zhiyu Jiang. Offshore wind turbine operation and maintenance: A state-of-the-art review. *Renewable & Sustainable Energy Reviews*, 144:110886, 2021. [Q1,IF:12.110].

[4] **Zhengru Ren**, Amrit Verma$^*$, Behfar Ataei, Karl Henning Halse, and Hans Petter Hildre. Model-free anti-swing control of complex-shaped payload with offshore floating cranes and a large number of lift wires. *Ocean Engineering*, 228:108868, 2021. [Q1,IF:3.068].

[5] **Zhengru Ren**$^*$, Xu Han, Amrit Shankar Verma, Johann Alexander Dirdal, and Roger Skjetne. Sea state estimation based on vessel motion responses: improved smoothness and robustness using Bézier surface and L1 optimization. *Marine Structures*, 76:102904, 2021. [Q1,IF:2.708].

[6] **Zhengru Ren**$^*$, Roger Skjetne, Amrit Shankar Verma, Zhiyu Jiang, Zhen Gao, and Karl Henning Halse. Active heave compensation of floating wind turbine installation using a catamaran construction vessel. *Marine Structures*, 75:102868, 2021. [Q1,IF:2.708].

[7] Xu Han$^*$, Bernt Johan Leira, Svein Sævik, and **Zhengru Ren**. Onboard tuning of vessel seakeeping model parameters and sea state characteristics. *Marine Structures*, 78:102998, 2021. [Q1,IF:2.708].

[8] Amrit Shankar Verma*, Sandro Di Noi, **Zhengru Ren**, Zhiyu Jiang, and Julie J.E. Teuwen. Minimum leading edge protection application length to combat rain-induced erosion of wind turbine. *Energies*, 14(6):1629, 2021. [Q3,IF:2.702].

[9] Hongyu Zhou, **Zhengru Ren***, and Roger Skjetne. Stepwise path planning with anti-collision using stream function for marine vessels. *IEEE Transactions on Intelligent Transportation Systems*, 2021. Under review, [Q1,IF:6.319].

[10] **Zhengru Ren***, Bo Zhao, and Dong Trong Nguyen. Finite-time neural adaptive control of a class of nonlinear system: Proved by Bernoulli inequality. *IEEE Access*, 8:47768–47775, 2020. [Q1,IF:3.745].

[11] **Zhengru Ren**, Roger Skjetne, Zhiyu Jiang*, and Zhen Gao. Active single-blade installation using tugger line tension control and optimal control allocation. *International Journal of Offshore and Polar Engineering*, 30(2):220–227, 2020. [Q1,IF:0.604].

[12] Amrit Shankar Verma*, Zhiyu Jiang, **Zhengru Ren**, Marco Caboni, Hans Verhoef, Harald van der Mijle Meijer, Saullo G.P. Castro, and Julie J.E. Teuwen. A probabilistic long-term framework for site-specific erosion analysis of wind turbine blades: A case study of 31 Dutch sites. *Wind Energy*, 2021. [Q2,IF:2.646].

[13] Amrit Shankar Verma*, Zhiyu Jiang, **Zhengru Ren**, Zhen Gao, and Nils Petter Vedvik. Effects of wind-wave misalignment on a wind turbine blade mating process: impact velocities, blade root damages and structural safety assessment. *Journal of Marine Science and Application*, 19:218–233, 2020.

[14] Amrit Shankar Verma*, Zhiyu Jiang, **Zhengru Ren**, Weifei Hu, and Julie Teuwen. Effects of onshore and offshore environmental parameters on leading edge erosion of wind turbine blades: A comparative study. *Journal of Offshore Mechanics and Arctic Engineering*, 143(4):042001, 2020. [Q3,IF:1.186].

[15] Ming Song*, Bin Qin, Li Zhou, and **Zhengru Ren**. A three-dimensional model for strength assessment of type-c independent cargo tank structures. *Journal of Ship Production and Design*, 36(04):271–279, 2020. [Q4,IF:0.656].

[16] Roger Skjetne and **Zhengru Ren***. A survey on modeling and control of thruster-assisted position mooring systems. *Marine Structures*, 74:102830, 2020. [Q1,IF:2.708].

[17] **Zhengru Ren***, Roger Skjetne, and Zhen Gao. A crane overload protection controller for blade lifting operation based on model predictive control. *Energies*, 12(1):50, 2019. **ESI highly-cited paper** [Q3,IF:2.702].

[18] **Zhengru Ren***, Roger Skjetne, Zhiyu Jiang, Zhen Gao, and Amrit Shankar Verma. Integrated GNSS/IMU hub motion estimator for offshore wind turbine blade installation. *Mechanical Systems and Signal Processing*, 123:222–243, 2019. **ESI highly-cited paper** [Q1,IF:6.471].

[19] Amrit Shankar Verma*, Zhiyu Jiang, **Zhengru Ren**, Zhen Gao, and Nils Petter Vedvik. Response-based assessment of operational limits for mating blades on monopile-type offshore wind turbines. *Energies*, 12(10):1867, 2019. [Q3,IF:2.702].

[20] Amrit Shankar Verma, Zhiyu Jiang*, Nils Petter Vedvik, Zhen Gao, and **Zhengru Ren**. Impact assessment of a wind turbine blade root during an offshore mating process. *Engineering Structures*, 180:205–222, 2019. [Q1,IF:3.548].

[21] Ming Song, Wei Shi, **Zhengru Ren**, and Li Zhou*. Numerical study of the interaction between level ice and wind turbine tower for estimation of ice crushing loads on structure. *Journal of Marine Science and Engineering*, 7(12):439, 2019. [Q2,IF:2.033].

[22] **Zhengru Ren**, Zhiyu Jiang*, Roger Skjetne, and Zhen Gao. Active tugger line force control method for single blade installations. *Wind Energy*, 21:1344–1358, 2018. [Q2,IF:2.646].

[23] **Zhengru Ren**, Zhiyu Jiang*, Roger Skjetne, and Zhen Gao. Development and application of a simulator for offshore wind turbine blades installation. *Ocean Engineering*, 166:380–395, 2018. [Q1,IF:3.068].

[24] Jiafeng Xu, **Zhengru Ren***, Yue Li, Roger Skjetne, and Karl Henning Halse. Dynamic simulation and control of an active roll reduction system using free-flooding tanks with vacuum pumps. *Journal of Offshore Mechanics and Arctic Engineering*, 140:061302, 2018. [Q3,IF:1.186].

[25] Zhiyu Jiang, Zhen Gao, **Zhengru Ren**, Ye Li*, and Lei Duan. A parametric study on the blade mating process for monopile wind turbine installations under rough environmental conditions. *Engineering Structures*, 172:1042 – 1056, 2018. [Q1,IF:3.548].

[26] Zhiyu Jiang, Weifei Hu, Wenbin Dong, Zhen Gao, and **Zhengru Ren***. Structural reliability analysis of wind turbines: a review. *Energies*, 10:2099, 2017. [Q3,IF:2.702].

[27] Hui Liang*, Zhi Zong, Lei Sun, Li Zou, Li Zhou, Yanjie Zhao, and **Zhengru Ren**. Generalized weissinger's L-method for prediction of curved wings operating above a free surface in subsonic flow. *Journal of Engineering Mathematics*, 83(1):109–129, 2013. [Q3,IF:1.434].

**Conference papers**

[1] Amrit Shankar Verma, Zhiyu Jiang, **Zhengru Ren**, and Julie Teuwen. Leading edge erosion of wind turbine blades: Effects of environmental parameters on impact velocities and erosion damage rate. In *ASME 2020 39th International Conference on Ocean, Offshore and Arctic Engineering*, pages OMAE2020–18173. American Society of Mechanical Engineers, 2020.

[2] Zhiyu Jiang, Bjørnholm Marius, Jiamin Guo, Wenbin Dong, **Zhengru Ren**, and Amrit Shankar Verma. Damage identification of a jacket support structure for offshore wind turbines. In *The 15th IEEE Conference on Industrial Electronics and Applications (ICIEA2020)*, pages 995–1000. IEEE, 2020.

[3] Amrit Shankar Verma, Zhen Gao, Zhiyu Jiang, **Zhengru Ren**, and Nils Petter Vedvik. Structural safety assessment of marine operations from a long-term perspective: A case study of offshore wind turbine blade installation. In *ASME 2019 38th International Conference on Ocean, Offshore and Arctic Engineering*. American Society of Mechanical Engineers Digital Collection, 2019.

[4] Jingzhe Jin, Vatne Sigrid Ringdalen Jiang, Zhiyu, **Zhengru Ren**, Yuna Zhao, and Zhen Gao. Installation of pre-assembled offshore wind turbines using a catamaran vessel and an active gripper motion control method. In *Grand Renewable Energy 2018 Proceedings*, 2018.

[5] Zhen Gao, Amrit Shankar Verma, Yuna Zhao, Zhiyu Jiang, and **Zhengru Ren**. A summary of the recent work at NTNU on marine operations related to installation of offshore wind turbines. In *ASME 2018 37th International Conference on Ocean, Offshore and Arctic Engineering*, page V11AT12A044. American Society of Mechanical Engineers, 2018.

[6] **Zhengru Ren**, Zhiyu Jiang, Roger Skjetne, and Zhen Gao. Single blade installation using active control of three tugger lines. In *The 28th International Ocean and Polar Engineering Conference*, pages 594–601. International Society of Offshore and Polar Engineers, 2018.

[7] Zhiyu Jiang, **Zhengru Ren**, Zhen Gao, Karl Henning Halse, and Peter Christian Sandvik. Mating control of a wind turbine tower-nacelle-rotor assembly for a catamaran installation vessel. In *Proceedings of the 2018 International Ocean and Polar Engineering Conference*, pages 584–593. International Society of Offshore and Polar Engineers, 2018.

[8] **Zhengru Ren**, Roger Skjetne, and Zhen Gao. Modeling and control of crane overload protection during marine lifting operation based on model predictive control. In *ASME 2017 36th International Conference on Ocean, Offshore and Arctic Engineering*, pages OMAE2017–62003. American Society of Mechanical Engineers, 2017.

[9] Jiafeng Xu, **Zhengru Ren**, Yue Li, Roger Skjetne, and Karl Henning Halse. Dynamic simulation and control of an active roll reduction system using free-flooding tanks with vacuum pumps. In *ASME 2017 36th International Conference on Ocean, Offshore and Arctic Engineering*, pages OMAE2017–61292. American Society of Mechanical Engineers, 2017.

[10] **Zhengru Ren** and Roger Skjetne. An on-site current profile estimation algorithm for a moored floating structure. *IFAC-PapersOnLine*, 49(23):153–158, 2016.

[11] **Zhengru Ren** and Roger Skjetne. A tension-based position estimation solution of a moored structure and its uncertain anchor positions. *IFAC-PapersOnLine*, 49(23):251–257, 2016.

[12] **Zhengru Ren**, Roger Skjetne, and Øivind Käre Kjerstad. A tension-based position estimation approach for moored marine vessels. *IFAC-PapersOnLine*, 48(16):248–253, 2015.

[13] **Zhengru Ren**, Roger Skjetne, and Vahid Hassani. Supervisory control of line breakage for thruster-assisted position mooring system. *IFAC-PapersOnLine*, 48(16):235–240, 2015.

## Reviewer for international journals and conferences

Ocean Engineering

Applied Ocean Research

Journal of Offshore Mechanics and Arctic Engineering

Journal of Marine Science and Engineering

IEEE Transactions on Neural Networks and Learning Systems

IEEE Transactions on Systems, Man, and Cybernetics: Systems

IEEE Access

Engineering Structures

Journal of Materials Research and Technology

International Journal of Energy Applications and Technologies

Energies

IFAC Conference on Control Applications in Marine Systems (CAMS)

International Conference on Ocean, Offshore and Arctic Engineering (OMAE)

International Offshore and Polar Engineering Conference (ISOPE)

International Offshore Wind Technical Conference (IOWTC)

IFAC World Congress

## Other experience

### Fellowships and awards

PhD fellowship, SFI MOVE/NTNU AMOS, NTNU, 2016–2018

Excellence prize, National Computer Program-Designing Competitions, China, 2012

Outstanding graduates, DLUT, 2012

3rd prize, National Modern Distance Education and Practice Teaching High-End Academic BBS, China, 2011

Provincial 2nd and 3rd prize, National 3D Innovation Design Competition, Liaoning, 2011

National 1st prize, BeiDou-Cup China Adolescents Science & Technology Innovation Contest, China, 2011

### Computer Skills

MATLAB, Simulink, LabVIEW, 20-SIM, Maple, VB, C/C++, R, FORTRAN, Arduino

ProE, UG, Inventor, Rhino, AutoCAD

HAWC2, FAST, Fluent, Ansys, SIMA, DeepC, ShipX, Latex, PhotoShop

### Language proficiency

Chinese: Native

English: Fluent

Norwegian: A2

## Referees

**Roger Skjetne**
Professor of Marine Control Engineering
Department of Marine Technology
Norwegian University of Science and Technology
O. Nielsens Veg 10, Tyholt, N-7491 Trondheim, Norway
roger.skjetne@ntnu.no, +47 92813672

**Zhen Gao**
Professor of Marine Structures
Department of Marine Technology
Norwegian University of Science and Technology
O. Nielsens Veg 10, Tyholt, N-7491 Trondheim, Norway
zhen.gao@ntnu.no, +47 91751114

**Houxiang Zhang**
Professor, Institute leader for research
Department of Ocean Operations and Civil Engineering
Norwegian University of Science and Technology
hozh@ntnu.no, +47 97835811

**Karl Henning Halse**
Associate Professor, Vice Dean for the bachelor education
Department of Ocean Operations and Civil Engineering
Norwegian University of Science and Technology
NTNU Ålesund, Postboks 1517, NO-6025 Ålesund, Norway
karl.h.halse@ntnu.no, +47 95227613

**Zhiyu Jiang**
Associate Professor
Department of Engineering Sciences
Univerisity of Adger
D3103, Jon Lilletuns vei 9, NO-4879, Grimstad, Norway
zhiyu.jiang@uia.no, +47 37233489