

TAO SUN

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SUMMARY

Tao Sun currently is a postdoctoral with Wearable systems Laboratory at Shanghai Jiao Tong University, supervised by Prof. Peter B. Shull. His research aim is to investigate biomechanics of lower extremity by modeling kinetics using machine learning. He received a PhD degree at college of Mechanical and Electrical Engineering from the Nanjing University of Aeronautics and Astronautics in April 2021. His PhD research aim is to investigate adaptive neural control based on central pattern generators, reflex chains, sensory feedback and learning mechanisms. The control can not only enable legged robots (e.g., quadruped robots) to autonomously generate adaptive self-organized locomotion and also contribute to the understanding of biological neural mechanisms of animals. A secondary objective is to develop a generic adaptive neural controller, which can directly be applied in various legged robots with different morphology.



EDUCATION

Shanghai Jiao Tong University

Postdoc.

Shanghai, China

Jun. 2021 – Present

Nanjing University of Aeronautics and Astronautics

PhD of Machine design and theory

Nanjing, China

Apr. 2016 – Apr. 2021

Nanjing University of Aeronautics and Astronautics

Master of Machine design and theory

Nanjing, China

Sep. 2014 – Sep. 2016

Anhui Polytechnic University

Bachelor of Process Equipment and Control Engineering

Wuhu, China

Sep. 2010 – May 2014

EXPERIENCE

PhD student

College of Mechanical and Electrical Engineering, Nanjing University of Aeronautics and Astronautics

Oct. 2020 – Present

Nanjing, China

- Preparing my thesis for applying a PhD degree

Visiting researcher

SDU Biorobotics, University of Southern Denmark

Oct. 2019 – Sep. 2020

Odense, Denmark

- Developed a distributed force feedback-based reflex with online learning for adaptive quadruped robot control
- Performed a comparative study of adaptive interlimb coordination mechanisms for self-organized robot locomotion (comparing between continuous phase modulation and phase resetting of decoupled CPGs)

PhD student

College of Mechanical and Electrical Engineering, Nanjing University of Aeronautics and Astronautics

Jan. 2018 – Sep. 2019

Nanjing, China

- Investigated neural control with adaptive physical and neural communications for reusable quadruped locomotion
- Investigated adaptive neural control for self-organized locomotion and obstacle negotiation of quadruped robots
- Developed a small-sized reconfigurable quadruped robot with multiple sensory feedback

Robotic engineer (intern)

The 609 Research Institute of China Aviation Industry

Apr. 2016 – Dec. 2017

Nanjing, China

- Developed control algorithms for high slope walking of a hydraulic quadruped robot
- Developed a hardware system of a hydraulic quadruped robot

Master student

College of Astronautics, Nanjing University of Aeronautics and Astronautics

Jun. 2014 – Sep. 2016

Nanjing, China

- Investigated path planning with lidar of mobile robots
- Investigated gait planning and foot trajectory optimization for efficient locomotion of hydraulic quadruped robots

PRESENTATION

Oral

- International Youth Conference of Bionic Engineering (IYCBE 2018), "Adaptive neural control for self-organized locomotion and obstacle negotiation of quadruped robots", 7th-9th November 2018, Odense, Denmark.
- China Denmark Bio-inspired Engineering Seminar, "Adaptive neural control with adaptive physical and neural communications for quadruped locomotion", 15th October 2018, Nanjing, China.

Post

- The 2nd National Robot Innovation and Design Competition, "A small-sized quadruped robot for studying bio-inspired locomotion control", 23rd – 26th September 2020, Xi'an, China.
- The 27th IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN 2018), "Adaptive neural control for self-organized locomotion and obstacle negotiation of quadruped robots", Aug. 2018, Nanjing, China.

AWARD

- The third prize in the 2nd in Robot Innovation and Design Competition of China Graduate Students, 23rd – 26th September 2020, Xi'an, China.
- The third prize of "Jerry Cup" in Energy Equipment Innovation Design Competition of China Graduate Students, 2020, China.
- Scholarship for supporting visiting research one year in Denmark from China Scholarship Council, 2019, China
- The third prize in the 7th "Tiangong Cup" of postgraduate innovative experiment competition, 30th November 2018, China.

PUBLICATIONS

1. **Sun, T.**, Shao, D., Dai, Z., & Manoonpong, P. (2018, August). Adaptive neural control for self-organized locomotion and obstacle negotiation of quadruped robots. In 2018 27th IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN) (pp. 1081-1086). IEEE.
2. **Sun, T.**, Xiong, X., Dai, Z., & Manoonpong, P. (2020). Small-Sized Reconfigurable Quadruped Robot With Multiple Sensory Feedback for Studying Adaptive and Versatile Behaviors. *Frontiers in Neurorobotics*, 14, 14.
3. **Sun, T.**, Dai, Z., & Manoonpong, P. (2020.1). Robust and reusable self-organized locomotion of legged robots under adaptive physical and neural communications. *IEEE Transactions on Cybernetics* (revision).
4. **Sun, T.**, Dai, Z., & Manoonpong, P. (2020.8). Distributed-force-feedback-based reflex with online learning for adaptive quadruped motor control. *Neural Networks*, <https://doi.org/10.1016/j.neunet.2021.06.001>.
5. **Sun, T.**, Xiong, X., Dai, Z., Dai O., & Manoonpong, P. (2020). A comparative study of adaptive interlimb coordination mechanisms for self-organized robot locomotion. *Frontiers in robotics and AI*.
6. Mario Calandra, Luca Patane, **Tao Sun**, Paolo Arena, Manoonpong P. (2020). Echo State Networks for estimating exteroceptive conditions from proprioceptive states in quadruped robots. *Frontiers in Neurorobotics* (under review)
7. Sun T., Dai Z. & Manoonpong, P. (2018, Nov.) Self-organized quadruped locomotion and body attitude stabilization under adaptive neural control and reflexes. *Proc. 2nd Int. Youth Conf. Bionic Eng.* (pp. 41-42)

TEACHING

1. Teaching "Phase adaptation under physical and neural communication for stable self-organized locomotion" in Embodied AI and Robotics Course, University of Southern Denmark, Nov. 7th 2019.
2. Teaching "Decoupled CPGs-based control for self-organized locomotion of legged robot" in Adaptive Locomotion Control Course, Nanjing University of Aeronautics and Astronautics, Dec. 5th 2020.

TECHNICAL SKILLS

Languages: Matlab, Python, C/C++, Lua, Latex

Platforms: Ubuntu, ADAMAS, ROS, CoppeliaSim, LpzRobots, Webots

Developer Tools: Git, Eclipse, Vim, UG NX, Inkscape, Kdenlive