Tao Sun

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Summary

I have a PhD in mechanical and electrical engineering and a postdoc in wearables for movement biomechanics and have a strong background in biomechanics, embedded programming, machine learning, and IMUs. I am seeking a full-time engineering position related to human biomechanics and wearable IMUs. I am currently a postdoctoral researcher with the Wearable Systems Laboratory at Shanghai Jiao Tong University, supervised by Prof. Peter Shull. My postdoctoral research aim is to investigate the biomechanics of humans in landing tasks using wearable sensors (IMUs) and machine learning. My PhD research aim was to investigate adaptive neural control based on central pattern generators, reflex chains, sensory feedback, and learning mechanisms. The control algorithm can not only enable legged robots (e.g., quadruped robots) to autonomously generate adaptive self-organized locomotion and also contribute to the understanding of animals' biological neural mechanisms. A secondary objective of the research was to develop a generic adaptive neural controller, which can directly be applied in various legged robots with different morphology.

Education

Shanghai Jiao Tong University   Shanghai, China
Postdoctoral researcher in Wearable IMU AI Algorithms   *Jun. 2021 – Present*

Nanjing University of Aeronautics and Astronautics   Nanjing, China
PhD in Mechanical and Electrical Engineering   *Apr. 2016 – Apr. 2021*

Nanjing University of Aeronautics and Astronautics   Nanjing, China
Master in Mechanical and Electrical Engineering   *Sep. 2014 – Sep. 2016*

Anhui Polytechnic University   Wuhu, China
Bachelors of Science in Process Equipment and Control Engineering   *Sep. 2010 – May 2014*

Publications

1. **Sun, T.**, Li, DX, Fan, BF., Tian, T., Shull, P., (2022, August). Real-time ground reaction force and knee extension moment estimation during drop landings via modular LSTM modeling and wearable IMUs. IEEE Journal of Biomechanical and Health Informatics (revision).

2. **Sun, T.**, Dai, Z., & Manoonpong, P. (2022.11). Robust and reusable self-organized locomotion of legged robots under adaptive physical and neural communications. Frontiers in Neural Circuits (revision).

3. **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.

4. **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.

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. Calandra, M., Patane, L., **Sun, T.**, Arena, P, Poromate, M. (2020). Echo State Networks for estimating exteroceptive conditions from proprioceptive states in quadruped robots. Frontiers in Neurorobotics.

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)

8. **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.

EXPERIENCE

Senior Embedded Software Engineer   Oct. 2021 – Present
SageMotion   *Shanghai, China*
- Developed Firmware for Wearable IMU system
- Developed APP for estimating duty factor of gait during walking using wearable IMUs

Visiting researcher   Oct. 2019 – Sep. 2020
SDU Biorobotics, University of Southern Denmark   *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)

Robotic engineer (intern)   Apr. 2016 – Dec. 2017
The 609 Research Institute of China Aviation Industry   *Nanjing, China*
- Developed control algorithms for high slope walking of a hydraulic quadruped robot
- Developed a hardware system of a hydraulic quadruped robot

PRESENTATIONS

- 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.

- 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.

AWARDS

- The third prize in the 2nd in Robot Innovation and Design Competition of China Graduate Students, 23rd – 26th September 2020, Xi'an, China.

- T he third prize of "Jerry Cup" in the 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.

TEACHING

1. Guest Lecture "How to design your legged robot" in Design and Manufacture Course, Shanghai Jiao Tong University, Dec. 8th 2022.

2. Guest Lecture "How to design your legged robot" in Design and Manufacture Course, Shanghai Jiao Tong University, Nov. 28th 2021.

3. 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.

4. 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.

TECHNICAL SKILLS

Languages: Matlab, Python, C/C++, Lua, Latex
Platforms: Ubuntu, ADAMAS, ROS, CoppeliaSim, LpzRobots, Webots
Developer Tools: Git, Github, Eclipse, Vim, UG NX, Inkscape, Kdenlive
Libraries: Pytorch, Tensorflow, Scikit-learn