

Tao Shen

College of Aeronautics and Engineering
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Professional Positions

Kent State University, Kent, Ohio

Assistant Professor in the College of Aeronautics and Engineering Jan. 2019 – Present

University of Alabama, Tuscaloosa, AL

Postdoctoral Researcher in the Department of Mechanical Engineering Aug. 2016 – Dec. 2018

Educational Background

University of Nebraska-Lincoln, Lincoln, NE

Aug. 2012 – Aug. 2016

Ph.D. Mechanical Engineering and Applied Mechanics

Minor: Computer Science

Jilin University, Changchun, China

Sep. 2010-Jun. 2012

Master student in Mechatronics

Northeastern University, Shenyang, China

Sep. 2006-Jul. 2010

B.E. Mechanical Engineering and Automation

Research Interests

Mechatronics, surgical robots, walking assistant robot, medical stimulator, UAV medical application, wire-driven robot, design, modeling and dynamics analysis.

Major Research Experiences

Assistant professor, Kent State University

Jan. 2019 – Present

- ✧ Walking assistant robots
- ✧ Wire-driven actuation
- ✧ Robots for minimally invasive surgeries
- ✧ Robot and devices for medical application

Postdoctoral Researcher, University of Alabama

Aug. 2016 – Dec. 2018

- ✧ Designed a control system for a quadruped robot used for walking assistance.
- ✧ Designed and controlled a wheeled automatic robotic walker guided by an imaging processing system.
- ✧ Designed a control system for a medical device to help senior people to stand up from sitting pose.
- ✧ Designed PCB boards for prosthesis and orthosis devices.

Research Assistant, University of Nebraska – Lincoln

Aug. 2012 – Jul. 2016

- ✧ Designed, controlled, tested and analyzed a Multifunctional NOTES (Natural Orifice Transluminal Endoscopic Surgery) Robot (main project).
- ✧ Designed an image processing algorithm to automatically detect crops/weeds in the agricultural field.
- ✧ Designed and controlled a serial lightweight robotic arm attached to an unmanned aerial vehicle (UAV) for position tracking.

Teaching

Summary of lecture courses: Signals and Circuits (Develop and teach); Linear System Analysis and Control (Develop and teach); Robotics: Kinematics and Design (Develop and teach); Medical Robots (Developing)

Publications

Journal articles

- ✧ Joseph Pinkl; **Tao Shen**; Jinsai Cheng; John Hawks; Jianxin Bao. 2025. "Developing a Calibration Method to Minimize Variability in Auditory Evoked Potentials" *Journal of the Association for Research in Otolaryngology*. <https://doi.org/10.1007/s10162-025-00982-5>
- ✧ Cheng, J., and **Shen, T.** 2024. "Development and Optimization of a Noncircular Pulley for Motion Decoupling in Cable-Driven Serial Robots." ASME. *J. Mech. Des.* 146(11): 113301. <https://doi.org/10.1115/1.4065278>
- ✧ Jinsai Cheng, **Tao Shen**, 2023, "A smart walker based on a hybrid motion model and machine learning method", *Mechatronics*, Volume 96, 2023, 103069, <https://doi.org/10.1016/j.mechatronics.2023.103069>.
- ✧ **Shen, T.**, Afsar, M. R., Haque, M. R., McClain, E., Meek, S. G., and Shen, X. 2022. "Quadrupedal Human-Assistive Robotic Platform (Q-HARP): Design, Control, and Preliminary Testing." ASME. *J. Mechanisms Robotics*. April 2022; 14(2): 021004. <https://doi.org/10.1115/1.4052321>
- ✧ **Shen, T.**, Afsar, M.R., Zhang, H. Ye, C., Shen, X., 2020, "A 3D Computer Vision-Guided Robotic Companion for Non-Contact Human Assistance and Rehabilitation". *J Intell Robot Syst* (2020). <https://doi.org/10.1007/s10846-020-01258-1>
- ✧ Li, X., Gao, R., **Shen, T.**, 2019, "Analysis of Material Motion Characteristics of Vertical Nonlinear Synchronous Vibration Dryer," *Transactions of the Canadian Society for Mechanical Engineering*, <https://doi.org/10.1139/tcsme-2018-0247>
- ✧ **Shen, T.**, Nelson, C., Bradley, J., 2019, "Design of a Model-free Cross-coupled Controller with Application to Robotic NOTES," *Journal of Intelligent and Robotic Systems*, pp. 1-17. <https://doi.org/10.1007/s10846-018-0836-2>
- ✧ **Shen, T.**, Hennings, D., Nelson, C., Oleynikov, D., 2018, "Performance of a Multifunctional Robot for Natural Orifice Transluminal Endoscopic Surgery," *Surgical Innovation*, 25 (4), pp. 364-373.
- ✧ Li, X., Sun, Y., **Shen, T.**, 2018, "Vibration Stability Analysis of Dual Motor Harmonic Synchronous Excitation Nonlinear Vibration Conveyor," *Transaction of the Canadian Society for Mechanical Engineering*, 42 (4), pp. 419-426.
- ✧ Li, X., **Shen, T.**, 2017, "Nondestructive Testing System for Biological Product Based on Vibration Signal Analysis of Acceleration Sensor," *Journal of Vibroengineering*, 19 (3), pp. 2164 – 2173.
- ✧ **Shen, T.**, Nelson, C., Oleynikov, 2016, "Design and Analysis of a Bimanual Multifunctional Robot for NOTES," *Journal of Medical Device*, 10 (3), pp. 030903-3.
- ✧ Li, X., **Shen, T.**, 2016, "Dynamic Performance Analysis of Nonlinear anti-resonance Vibrating Machine with the Fluctuation of Materials Mass," *Journal of Vibroengineering*, 18 (2), pp. 978-988.
- ✧ **Shen, T.**, Askbarisamani, S., Nelson, C., Oleynikov, D., 2015, "Preliminary Validation Testing of a Multifunctional NOTES Robot," *Journal of Medical Device*, 9 (3), pp. 011004-3.
- ✧ **Shen, T.**, Nelson, C. A., Warburton, K., Oleynikov, D., 2015, "Design and Analysis of a Novel Articulated Drive Mechanism for Multifunctional NOTES Robot," *Journal of Mechanisms and Robotics*, 7(1), pp. 0110041-0110048.
- ✧ **Shen, T.**, Warburton, K., Pourghodrat, A., Nelson, C. A., Oleynikov, D., 2014, "A Novel Articulated Drive Mechanism for Multifunctional NOTES Robot," *Journal of Medical Devices*, 8 (3), pp. 030921-2.
- ✧ Li, X., **Shen, T.**, 2014, "Harmonic Vibration Synhronization Phenomenon Analysis of Dual Excitation Rotors Nonlinear Vibration System," *Journal of Vibroengineering*, 16 (6), pp. 1086-1090.

Conference papers

- ✧ Izel Tuncer, Md Nazmul Islam, Renhao Jin and **Tao Shen**. " UNIVERSAL JOINT ORTHOSIS (UJO): ASSISTIVE AND RESISTIVE MOVEMENT DEVICE FOR ASTRONAUTS AND MEDICAL REHABILITATION." *Proceedings of the 2025 Design of Medical Devices Conference*. Minneapolis, MN, USA. April 28–30, 2025.
- ✧ Anand, Md Nazmul Islam, Renhao Jin, Qiang Guan, Yan Sun, Gengqing Song and **Tao Shen**. "DEVELOPMENT OF A WEARABLE DEVICE FOR ASSISTING DIAPHRAGMATIC BREATHING." *Proceedings of the 2025 Design of Medical Devices Conference*. Minneapolis, MN, USA. April 28–30, 2025.
- ✧ W. Zhao, J. Cheng, **T. Shen** and X. Luo, "Towards a Safety Culture in Workplaces: Intelligent Rest Breaks

and Social Support," *2023 IEEE Symposium Series on Computational Intelligence (SSCI)*, Mexico City, Mexico, 2023, pp. 753-758, doi: 10.1109/SSCI52147.2023.10371861.

- ✧ J. Cheng and **T. Shen**, "Motion decoupling for cable-driven serial robots based on a noncircular pulley," *2023 IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM)*, Seattle, WA, USA, 2023, pp. 739-745, doi: 10.1109/AIM46323.2023.10196257.
- ✧ Cheng, J, Zhao, W, & **Shen, T.** "ROBOTIC ORTHOSIS BASED ON BEND SENSORS FOR OCCUPATIONAL MUSCULOSKELETAL DISORDER PREVENTION." *Proceedings of the 2023 Design of Medical Devices Conference. 2023 Design of Medical Devices Conference*. Minneapolis, MN, USA. April 17–19, 2023. V001T04A001. ASME. <https://doi.org/10.1115/DMD2023-1429>
- ✧ Cheng, J, Song, G, Guan, Q, & **Shen, T.** "Development of an Automated Transcutaneous Electrical Acustimulation Device Synchronized with Respiration for Treating Gastroesophageal Reflux Diseases." *Proceedings of the 2022 Design of Medical Devices Conference. 2022 Design of Medical Devices Conference*. Minneapolis, MN, USA. April 11–14, 2022. V001T10A001. ASME. <https://doi.org/10.1115/DMD2022-1012>
- ✧ Bulbul Chowdhury, AMM, Cheng, J, Yu, D, & **Shen, T.** "Development of a Self-Decoupled Wire-Driven Robotic Universal Joint Toward Medical Application." *Proceedings of the 2022 Design of Medical Devices Conference. 2022 Design of Medical Devices Conference*. Minneapolis, MN, USA. April 11–14, 2022. V001T07A001. ASME. <https://doi.org/10.1115/DMD2022-1016>
- ✧ Peng, C, & **Shen, T.** "Development of an Oropharyngeal Swab Assembly." *Proceedings of the 2021 Design of Medical Devices Conference. 2021 Design of Medical Devices Conference*. Minneapolis, MN, USA. April 12–15, 2021. V001T04A004. ASME. <https://doi.org/10.1115/DMD2021-1032>
- ✧ Peng, C, Chowdhury, AMMB, Cheng, J, George, RL, & **Shen, T.** "Development of a Robotic Landing System for UAVs Applied in Various Terrains." *Proceedings of the ASME 2020 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference*. Volume 10: 44th Mechanisms and Robotics Conference (MR). Virtual, Online. August 17–19, 2020. V010T10A070. ASME. <https://doi.org/10.1115/DETC2020-22606>
- ✧ Chowdhury, AMMB, Cheng, J, Cullado, MJ, & **Shen, T.** "Design and Analysis of a Wire-Driven Multifunctional Robot for Single Incision Laparoscopic Surgery." *Proceedings of the ASME 2020 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference*. Volume 10: 44th Mechanisms and Robotics Conference (MR). Virtual, Online. August 17–19, 2020. V010T10A046. ASME. <https://doi.org/10.1115/DETC2020-22471>
- ✧ Chowdhury, A. M. M.B, Cullado, M.J., and **Shen, T.**, 2020. "A Wire-Driven Multifunctional Manipulator for Single Incision Laparoscopic Surgery." *Proceedings of the 2020 Design of Medical Devices Conference. 2020 Design of Medical Devices Conference*. Minneapolis, Minnesota, USA. April 6–9, 2020. V001T06A003. ASME. <https://doi.org/10.1115/DMD2020-9015>
- ✧ **Shen, T.**, Afsar, M. R., Haque, M. R., McClain, E., Meek, S., Shen, X., 2019, "A Human-assistive Robotic Platform with Quadrupedal Locomotion," *Proceedings of IEEE 16th International Conference on Rehabilitation Robotics*, pp. 305-310.
- ✧ Zheng, H., **Shen, T.**, Afsar, M. R., Kang, I., Young A. J., Shen, X., 2019, "A Semi-Wearable Robotic Device for Sit-to-stand Assistance," *Proceedings of IEEE 16th International Conference on Rehabilitation Robotics*, pp. 204-209.
- ✧ **Shen, T.**, Afsar, M. R., Zhang, H., Ye, C., Shen, X., 2018, "Development of a Motorized Robotic Walker Guided by an Image Processing System for Human Walking Assistance and Rehabilitation," *Proceedings of ASME 2018 Dynamic System and Control Conference*, pp. DSCC2018-9223.
- ✧ **Shen, T.**, Nelson, C., Oleynikov, D., 2017, "A Pan/Tilt Surgical Camera with Parallel Structure and Elastic Platform," *Proceedings of 2017 Design of Medical Device Conference*, pp. DMD2017-3327.
- ✧ Afsar, M. R., Wadsworth, M., **Shen, T.**, Zhang, H., Ye, C., Shen, X., 2017, "A Motorized Robotic Walker for Human Walking Assistance," *Proceedings of 2017 Design of Medical Device Conference*, pp. DMD2017-3501.
- ✧ Fischer, S., **Shen, T.**, Nelson, C., Oleynikov, 2017, "Design of an Adjustable Table Mount for Multifunctional NOTES Robot," *Proceedings of 2017 Design of Medical Device Conference*, pp. DMD2017-3329.
- ✧ Shen, T, Warburton, K, Nelson, CA, & Oleynikov, D. "Design and Analysis of a Novel Articulated Drive

Mechanism for Multifunctional NOTES Robot." *Proceedings of the ASME 2014 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference*. Volume 5A: 38th Mechanisms and Robotics Conference. Buffalo, New York, USA. August 17–20, 2014. V05AT08A003. ASME. <https://doi.org/10.1115/DETC2014-34369>

- ✧ Yang, B., Yang, Y., Zhang, Y., Chen, X., Li, H., **Shen, T.**, 2012, "Development of Operator Seat Vibration Test Device of Earth-moving Machinery and Its Control System," *Proceedings of 2012 IEEE International Conference on Mechatronics and Automation*, pp. 366-370.
- ✧ Kong, Y., Zhao, D., Yang, B., **Shen, T.**, Li, H., Han, K., 2012, "Static Output Feedback Control for Active Suspension Using PSO-DE/LMI Approach," *Proceedings of 2012 IEEE International Conference on Mechatronics and Automation*, pp. 366-370.
- ✧ Zhao, D., Li, Z., Tian, B., **Shen, T.**, 2012, "Research on Fuzzy-sliding Mode Controller for Active Suspension System," *Proceedings of the 2012 Third International Conference on Mechanic Automation and Control Engineering*, pp. 3554-3557.
- ✧ Zhao, D., **Shen, T.**, Yang, B., 2012, "Research on Control Strategy for Active Suspension Based on Inertial Control Theory," *The 2011 International Conference on Advances in Construction Machinery and Vehicle Engineering*.

Non-referred/posters

- ✧ Cheng, J., **Shen, T.**, "Exploration of the Design, Dynamics and Control of Self-Decoupled, Cable-Driven Serial Robots" 2024 FRR-NRI PI meeting.
- ✧ Cheng, J., Xiu, G., **Shen, T.**, 2024, "A novel noncircular pulley for motion decoupling in serial cable-driven robots" Ohio Academy of Science's Annual Meeting.
- ✧ Joseph Pinkl, John Hawks, Jinsai Chen, **Tao Shen**, & Jianxin Bao, 2023, "Developing a Calibration Method for Reducing Peak Amplitude Variability in Auditory Evoked Potentials," ARO
- ✧ Cheng, J., **Shen, T.**, "Exploration of the Design, Dynamics and Control of Self-Decoupled, Cable-Driven Serial Robots" 2023 FRR-NRI PI meeting.
- ✧ **Shen, T.**, Shen, X., "Quadruped Robots: Challenges and Strategies," *Challenges and Solutions for Legged Robotics, workshop at 2019 American Control Conference*, Philadelphia, USA.
- ✧ Afsar, M.R., Wadsworth, M., **Shen, T.**, Shen, X., Zhang, H., Ye, C. "NRI: Collaborative Research: Quadrupedal Human-assistive Robotic Platform (Q-HARP), 2016 and 2017 NRI PI meeting.
- ✧ 2016 Professional workshop for Research Fair Postdoc and Faculty Events
- ✧ **Shen, T.**, Nelson C., 2014, "Robotic NOTES: Challenges and Design Strategies," IROS2014: Community Consensus Workshop Poster.

Publications in preparation

- ✧ Guodong Xiu; Jinsai Cheng; **Tao Shen**. 2025. "The development and analysis of a cable-driven serial robot with a full actuation" *Journal of Mechanical Engineering Science (submitted)*
- ✧ Jinsai Cheng, **Tao Shen**, 2025, "User intention detection for a smart walker based on LSTM and vertical interaction force" (*draft and revise*).

Patents

Issued

- ✧ Shen, X., **Shen, T.**, Afsar, M. R., Ye, C., 2020, "Motorized Robotic Walker Guided by an Image Processing System for Human Walking Assistance". US10667980B2.

Published

- ✧ **Shen, T.**, Peng, C., 2021, "Oral Sample Collection or Delivery Device and Methods", International patent. WO2021206984. https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2021206984&_cid=P12-KZIY1G-74182-1

Disclosed

- ✧ Yanhai Du, Dhruba Panthi, **Tao Shen**, Hai Fend, Sulata Sahu, Patrick Backer, Solemon Ibrahim, "A liquid Fuel On-Board Desulfurization System" U.S. Application Serial No.: 63/513,196. (Provisional patent was filed on 07/12/2023, and non-provisional patent was filed on 07/12/2024)
- ✧ **Tao Shen**, Jinsai Cheng, "Low-level current signal generator" U.S. Application Serial No.: 63/733,750.

(Filed on 12/13/2024)

- ✧ **Tao Shen**, A M Masum Bulbul Chowdhury, “A Wire-driven robotic manipulator with tool changing functionality for minimally invasive surgery” U.S Application Serial No.: 63/181,554 (Filed on 04/29/2021)

Grants and Contracts

Current

- ✧ National Science Foundation-CMMI Tao Shen (PI) 03/01/2022-02/28/2026
Project Title: ERI: Exploration of the Design, Dynamics and Control of Self-Decoupled, Cable-Driven Serial Robots.
Total award: \$198,978
Amount/percentage allocated for Shen’s role: 100%
Role: PI (**Single PI**)
- ✧ National Science Foundation-EEC Shihab (PI) 05/01/2023-04/30/2026
Project Title: REU Site: Research Experience for Undergraduates in Robotics and Autonomous Systems
Total award: \$402,740.00
Amount/percentage allocated for Shen’s role: 30%
Role: Co-PI

Completed

- ✧ Kent State University Research Council Tao Shen (PI) 01/2023-12/2024
Project Title: Energy harvesting using glass radiometer-modeling and realization
Total award: \$3,500
Role: PI
- ✧ National Institute of Health (1R42AG078721-01) Joseph Pinkl (PI) 10/2022-08/2023
Project Title: Developing a clinical diagnostic tool for age-related cochlear synaptopathy (Phase I)
Total award: \$555,803
Amount/percentage allocated for Shen’s role: \$84,816
Role: NIH subaward PI
- ✧ National Institute of Health (1R44DC018759-01) Jianxin Bao (PI) 07/01/2020-06/30/2022
Project title: Targeting multiple signaling pathways for tinnitus prevention and treatment
Total award: \$972,613
NIH subcontract: An Automated Multi-system for Sound-based Avoidance Behavior.
Amount/percentage allocated for Shen’s role: \$20,000
Role: NIH subcontract PI
- ✧ Department of Development (State of Ohio), Teck Fund Du (PI) 03/21/2022-01/31/2025
Project Title: Development of a Liquid Fuel Onboard Desulfurization System
Total award: \$300,000
Amount/percentage allocated for Shen’s role: \$2,000
Role: Engineering consultant
- ✧ US Air Force STTR (FA8649-20-P-0977) Du (PI) 09/23/2020-09/23/2021
Project Title: Jet Fuel On-Board Miniature Desulfurization and Stabilization
Total award: \$250,000
Amount/percentage allocated for Shen’s role: \$5,700
Role: Engineering consultant

Honors

- ✧ Excellence in Undergraduate Research Mentoring Award 2025
- ✧ Faculty merit award 2022
- ✧ Paper images selected for the featured cover for the Journal of Intelligent and Robotic Systems (“A 3D Computer Vision-Guided Robotic Companion for Non-Contact Human Assistance and Rehabilitation”,

Volume 100, Issues 3-4, 2020).

- ✧ Second place in 2014 ASME Student and Robot Design Competition Graduate Robot Division

Professional Activities

Proposal review

- ✧ NIH proposal reviewer for study section of BTSS, 2025
- ✧ NIH proposal reviewer for study section of Imaging Guided Interventions and Surgery (IGIS), 2024
- ✧ NSF proposal review panelist for the program of National Robotics Initiative 3.0
- ✧ Serve in grant scientific review (Scientific Reviewer): Medical Simulation & Information Sciences Research Program (MSISRP) in U.S Army Medical Research and Development COMMAND

Conference committee

- ✧ 2021- present, track chair of medical robot, Committee member for the Scientific Program Committee for the Design of Medical Devices Conference (Contributed Papers Committee)

Publication review

- ✧ IEEE Transactions on Robotics
- ✧ IEEE Transactions on Medical robotics and Bionics
- ✧ Journal of Mechanisms and Robotics
- ✧ Scientific Data
- ✧ Journal of Medical Device
- ✧ Journal of Intelligence and Robotics
- ✧ Control Engineering Practice
- ✧ Robotica
- ✧ International Journal of Intelligent Robotics and Application
- ✧ IEEE Transactions on Medical Robotics and Bionics
- ✧ Journal of Rehabilitation and Assistive technologies Engineering
- ✧ International Journal of Environmental Research and Public Health
- ✧ Surgical Innovation
- ✧ IEEE Control Systems Letters
- ✧ Mechanical Science
- ✧ Nonlinear Dynamics
- ✧ SN Applied Sciences
- ✧ Sensors
- ✧ Machines
- ✧ Journal of Field Robotics
- ✧ IEEE/ASME International Conference on Advanced Intelligent Mechatronics
- ✧ American Control Conference
- ✧ IEEE/RSJ international Conference on Intelligent Robots and Systems (IROS)

Advising

- ✧ Advising for high-school student interns 2020-2025 Summer

Judge

- ✧ FIRST (For Inspiration and Recognition of Science and Technology) Tech Challenge 2022- 2025
- ✧ SkyHack which is a competition focused on aviation design challenges opened to university students from all majors and disciplines across the USA 2019, 2021, 2023

Workshop

- ✧ "Quadruped Robots: Challenges and Strategies," *Challenges and Solutions for Legged Robotics, workshop at 2019 American Control Conference*, Philadelphia, USA 2019
- ✧ Participated in discussion in the Workshop of Future of Mechatronics and Robotics Education 2019

University Service

Kent State University (KSU) Service

✧ Design innovation hub (member)	2021- present
✧ KSU robotics Club (co-advisor)	2019- present
✧ Brain Health Research Institute (member)	2023- present
✧ Health Community Research Institute (member)	2019- present
✧ Graduate college Award review	02/2024
✧ Graduate Student Symposium (judge)	04/2024
✧ Undergraduate Symposium on Research, Scholarship and Creative Activity (judge)	04/2024
✧ KSU undergraduate SURE presentation (Judge)	10/2022
✧ David B. Smith scholarship (Reviewer)	03/2022

College of Aeronautics and Engineering (CAE) Service

✧ Graduate Faculty Advisory Council	2021- present
✧ Graduate Admission Committee	2021- present
✧ CAE Engineering Faculty Curriculum Development meeting	2019- present
✧ 3d printing management	2020- present
✧ Tenure-Track Faculty in Cybersecurity search committee	11/2024- 12/2024
✧ Business officer search committee	11/2023- 12/2023
✧ Academic lab manager search committee	07/2023
✧ NTT mechatronics engineering search committee	06/2024
✧ Graduate student handbook committee	Fall 2021
✧ Committee of graduate mechatronic engineering program	2020
✧ UAS (Unmanned Aircraft System) Degree Program Development Committee	2019
✧ Assoc Dean Research Search Committee	2019
✧ Mechatronics program committee	2019