Abbas Alili

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PROFESSIONAL SUMMARY

Innovative Applied Scientist with a Ph.D. in Electrical and Computer Engineering, specializing in machine learning, robotic perception, and control systems. Over three years of hands-on experience in developing and deploying advanced AI-driven solutions, including deep learning architectures and reinforcement learning algorithms for robotic applications. Proven track record of translating cutting-edge research into practical, production-ready models with multiple publications in top-tier journals and conferences. Passionate about pushing the boundaries of AI in robotics to enhance autonomous capabilities and improve human-robot interaction working with interdisciplinary teams.

EDUCATION

North Carolina State University   Raleigh, NC
Ph.D., Electrical and Computer Engineering (ECE)   Aug. 2019 – Oct. 2024

University of Stuttgart   Stuttgart, Germany
M.S., Electrical and Computer Engineering   Oct. 2011 – May 2014

Azerbaijan State University of Oil and Industry   Baku, Azerbaijan
B.S., Automation and IT   Sep. 2006 – Aug. 2010
Graduated with Honors Degree

TECHNICAL SKILLS

- **Programming Languages:** MATLAB, Python, C/C++,
- **Software and Tools:** ROS, PyTorch, TensorFlow, LabVIEW, Numpy, Scikit-Learn, SPICE, Power BI
- **Hardware Development:** Embedded Systems, Microcontrollers (Jetson, Arduino, Raspberry Pi)
- **Simulation and Modeling:** MATLAB/Simulink, MuJoCo

RESEARCH EXPERIENCE

North Carolina State University   Raleigh, NC
Graduate Research Assistant, (ECE & BME)   Aug. 2019 – Oct. 2024

Incorporation of user preferences into robot control: Utilized data-driven approaches to analyze user interaction data and fine-tune control algorithms for robotic knee prostheses. Developed and evaluated a novel prosthesis control framework using a user-controlled interface and a reinforcement learning-based algorithm to integrate user preferences into robot control.

- *Achievements:* Enabled user-preferred tuning for robotic knee prostheses. Demonstrated the framework's effectiveness in tuning 12 control parameters and confirmed users' ability to consistently identify their preferred knee profile.
- *Impact:* Showed uniqueness and importance of user preferences suggesting the potential for home or clinical application.

Towards Step Width Modulation Using a Robotic Hip Exoskeleton: Employed machine learning techniques to analyze real-time sensor data, optimizing control parameters for the exoskeleton and achieving step width control for the first time.

- *Achievements:* Demonstrated significant modulation of step width without affecting step length or gluteus medius EMG activity.
- *Impact:* Suggested potential for improving walking gait balance in assistive and rehabilitation applications.

A Reinforcement Learning-Based Approach for Proactive Step Width Control: Integrated advanced reinforcement learning techniques to optimize real-time exoskeleton control parameters through simulation and physical testing. Demonstrated the feasibility of controlling step width using a mediolaterally acting robotic hip exoskeleton by regulating admittance control parameters.

- *Achievements:* Utilized an RL-based algorithm to tune PID parameters, achieving an average step width control error of 1.2 cm with robotic hip exoskeleton.
- *Impact:* Paved the way for developing assistive and rehabilitation applications to enhance mediolateral gait balance in individuals with neurological impairments, the elderly, and amputees.

University of Stuttgart   Stuttgart, Germany
Extension of the Object Classification Types in Ultrasonic Object Localizations   Mar. 2014 – Sep. 2014

- Developed an algorithm and mathematical model for localizing curvy obstacles using ultrasonic sensors on cars, validated through MATLAB/Simulink, and implemented in C code for deployment, enabling detection beyond walls and flat surfaces.

PROFESSIONAL EXPERIENCE

Baku Higher Oil School (University)   Baku, Azerbaijan
Research Associate, Process Automation Department   Dec. 2014 – Aug. 2019

- Worked on a collaborative project with Kyungsung University (South Korea) to develop CCTV Video Analysis Technology for the surveillance and safety management of oil and gas facilities, improving monitoring and safety systems, and enhancing security and operational efficiency.
- Collected, preprocessed, and analyzed real plant operation data from the Stabilization unit in a petrochemical plant. Upon collected data we published a paper on a unique type of fuzzy model with an incomplete grid-type fuzzy rule base, which is crucial for the proposed plant monitoring system. The system effectively detected different operations using a moving window approach and calculating dissimilarity degrees based on real data.
- Actively engaged in establishment of "Internet of Things" laboratory, with the goal of setting up a state-of-the-art facility for IoT research and education, enabling advanced research and hands-on learning, fostering innovation and student engagement.

Robert Bosch GMBH   Leonberg, Germany
Master thesis student, Research and Development division   Mar. 2014 – Sep. 2014

- Designed algorithm in MATLAB to accurately identify curvy obstacles using ultrasonic sensors, enhancing obstacle detection accuracy and improving vehicle safety.
- Tested the algorithm with Simulink to ensure reliability in various driving conditions, validating detection capabilities, and achieving robust performance in real-world scenarios.
- Conducted pilot field tests with hardware interfaces and data acquisition systems to verify algorithm effectiveness in real-world conditions to ensure practical applicability.

Robert Bosch GMBH   Stuttgart, Germany
Intern, Car Multimedia and Instrumentation Engineering division   Apr. 2013 – Oct. 2013

- Engaged in designing PCB circuits for digital car clusters
- Troubleshooted hardware and software issues to diagnose and resolve technical problems.
- Documented technical specifications to maintain detailed records and manuals

SELECTED PUBLICATIONS

- **A. Alili**, V. Nalam, J. R. Tacca, M. Liu, J. Si, and H. Huang, Fellow, "*Towards Advancing Mediolateral Balance by Hip Exoskeletons: A Reinforcement Learning-Based Approach for Proactive Step Width Control*", IEEE Transactions on Robotics, *in Review*
- **A. Alili**, V. Nalam, J. Tacca and H. Huang, "*Exploring the Impact of Continuous Mediolateral Torque Application by Hip Exoskeleton on the Gait Balance of Non-Disabled Individuals*", IEEE 46th Annual International Conference of the IEEE Engineering in Medicine and Biology.
- **A. Alili**, A. Fleming, V. Nalam, M. Liu, J. Dean and H. Huang, "*Abduction/Adduction Assistance From Powered Hip Exoskeleton Enables Modulation of User Step Width During Walking*," in IEEE Transactions on Biomedical Engineering, vol. 71, no. 1, pp. 334-342, Jan. 2024.
- **A. Alili**, V. Nalam, A. Fleming, M. Liu, J. Dean and H. He Huang, "*Closed-Loop Feedback Control of Human Step Width During Walking by Mediolaterally Acting Robotic Hip Exoskeleton*," 2023 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Detroit, MI, USA, 2023, pp. 6097-6102.
- **A. Alili** et al., "*A Novel Framework to Facilitate User Preferred Tuning for a Robotic Knee Prosthesis*," in IEEE Transactions on Neural Systems and Rehabilitation Engineering, vol. 31, pp. 895-903, 2023.
- **A. Alili**, V. Nalam, M. Li, M. Liu, J. Si and H. H. Huang, "*User Controlled Interface for Tuning Robotic Knee Prosthesis*," 2021 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Prague, Czech Republic, 2021, pp. 6190-6195.

- Z. Yu, V. Nalam, **A. Alili** and H. H. Huang, "*A Wearable Robotic Rehabilitation System for Neuro-Rehabilitation Aimed at Enhancing Mediolateral Balance*," 2023 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Detroit, MI, USA, 2023, pp. 1-6.
- Yuan, J., Bai, X., **A. Alili**., Liu, M., Feng, J., & Huang, H. (2023). *Finding a Natural Fit: A Thematic Analysis of Amputees' Prosthesis Setting Preferences during User-Guided Auto-Tuning*. Proceedings of the Human Factors and Ergonomics Society Annual Meeting.
- Yuan, J., Bai, X., **A. Alili.**, Liu, M., Feng, J., & Huang, H. (2022). *Understanding the Preferences for Lower-Limb Prosthesis: A Think-Aloud Study during User-Guided Auto-Tuning*. Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 66(1), 2159–2163.
- M. Namazov, **A. Alili**. *Design Of Stable Takagi Sugeno Fuzzy Control System for Three Interconnected Tank System Via LMIs With Constraint On The Output*, IFAC-PapersOnLine, Volume 51, Issue 30, 2018, Pages 721-726, ISSN 2405-8963.
- G. Vachkov, **A. Alili** and M. Namazov, "*Grid fuzzy models with variable boundaries and their application to monitoring of plant operations*," 2017 IEEE International Conference on Mechatronics and Automation (ICMA), Takamatsu, Japan, 2017, pp. 1273-1278.

PATENTS

NCSU INVENTION DISCLOSURE   Submitted: 03/07/2023
Title: *A method to modulate step width during walking using a mediolateral hip exoskeleton and torque control*

TEACHING EXPERIENCE

North Carolina State University   Raleigh, NC
Teaching Assistant, Electrical and Computer Engineering Department   Aug. 2019 – Jan. 2021
- Assisted Dr. Troy Nagle with Digital Control Systems and Medical Devices.
- Assisted with formulation of course projects, engaged with student groups during project development, and administered grades.

Baku Higher Oil School (University)   Baku, Azerbaijan
Research Associate, Process Automation Department   Dec. 2014 – Aug. 2019
- Lectured courses in Process Control for Process Engineers and Microcontrollers, delivering comprehensive education that enhances student knowledge and skills, resulting in improved student competency and career readiness.
- Assisted Prof. Gancho Vachkov with courses such as Control Theory 1, Control Theory 2, and Process Control, supporting the teaching and exam process and ensuring high-quality education delivery, which strengthens the academic program quality.

HONORS & AWARDS

- *Author of Featured article, IEEE Transactions on Biomedical Engineering January Issue, 2024.*
- *Travel Award* from International Conference on Intelligent Robots and Systems (IROS 2023)
- Awarded with a *certificate of appreciation* in recognition of valued services and contributions as Robotics and Automation Society Chair (IEEE Region 3) (2021-2023)
- Awarded with an *honorable mention* as one of finalist papers for the Young Author Award at the TECIS2018 conference in Baku, Azerbaijan.
- *Awarded with certificate* for "active and invaluable contribution in organization of the conference entitled 18th IFAC Conference on Technology, Culture and International Stability – TECIS 2018 Baku, Azerbaijan".
- *[Invited TEDx Speaker](#)*

PRESENTATIONS

American Society of Biomechanics Thematic Poster Session   Aug. 2023
Title: *Step width and step length response to active abduction/adduction assistance provided by powered hip exoskeleton*

NCSU Human Factors and Applied Cognition, Brown Bag Talk series   Mar. 2023
Title: *Personalization of Robotic Prosthetic Devices: Challenges and Achievements*

GRANTS & FELLOWSHIPS

Gained full scholarship from Ministry of Education of Azerbaijan Republic to study master's degree in Stuttgart, Germany.	2011 – 2014

LEADERSHIP & OUTREACH

Led the organization of an open house event for the Neuromuscular Rehabilitation Engineering Laboratory (NREL) aimed at reaching clinicians and patients and disseminating our research	Oct. 10, 2023
Served as member of national organization committee of the TECIS2018 (18th IFAC Conference on Technology, Culture and International Stability) held in Baku, Azerbaijan	Sep. 13 – 15, 2018

PROFESSIONAL AFFILIATIONS

Chair of Robotics & Automation Society (RAS), IEEE Eastern North Carolina Section	2021 – 2023
Graduate Student Member, IEEE Robotics and Automation Society	2019 – Present
Graduate Student Member, IEEE Control Systems Society	2019 – Present