Ali KhalilianMotamed Bonab

EDUCATION

2022-Present	**Doctorate of Philosophy**	Emerging Digital Technologies Program, Telecommunications, Computer Engineering, and Photonics Institute (TeCIP), Scuola Superiore Sant'Anna, Pisa, Italy.
	Major	Perceptual Robotics
	Advisors	Prof. Dr. Antonio Frisoli 🅖 🌐,
	Co-Advisors	Assist. Prof. Dr. Domenico Chiaradia 🅖
2018-2021	**Master of Science**	Mechatronics Engineering Program, Faculty of Engineering and Natural Science, Sabanci University, Istanbul, Turkey. ✸
	Major	Mechatronics Engineering
	Advisor	Prof. Dr. Volkan Patoglu 🅖 🌐
	Thesis Title	Simulation-Based Multi-criteria Optimization of Exoskeletons to Reduce Metabolic Cost and Improve Energy Efficiency. 🔗
2013-2018	**Bachelor of Science**	Faculty of Mechanical Engineering, University of Tabriz, Tabriz, Iran. ✸
	Major	Mechanical Engineering
2009-2013	**Diploma**	National Organization for Development of Exceptional Talents (NODET). ↗

RESEARCH EXPERIENCE

Research Experience

Oct. 2022- Present	**Graduate Research Assistant**, Institute of Mechanical Intelligence, Scuola Superiore Sant'Anna, Pisa, Italy.
Apr. 2023- Feb. 2024	**Research Fellow**, Institute of Mechanical Intelligence, Scuola Superiore Sant'Anna, Pisa, Italy. [Contract Detail]
July 2022- Sep. 2022	**Research Fellow**, Institute of Mechanical Intelligence, Scuola Superiore Sant'Anna, Pisa, Italy. [Contract Detail]
Feb 2018- Apr. 2022	**Graduate Research Assistant**, Human Machine Interaction (HMI) Laboratory, Mechatronics Engineering Program, Faculty of Engineering and Natural Science (FENS), Sabanci University, Istanbul, Turkey.

RESEARCH INTERESTS

Physical Human-Robot Interaction, Human-in-the-loop Control and Optimization, Soft Robotics, Assistive & Rehabilitation Robotics, Wearable Haptics, Control Theory, Musculoskeletal Simulations, Multibody Dynamics, Kinematic Design.

PUBLICATIONS

Journal Papers

Nov. 2024   **Ali KhalilianMotamed Bonab**, Cristian Camardella, Antonio Frisoli, and Domenico Chiaradia. *Development and Experimental Validation of Hybrid Soft-Rigid Elbow Exosuit*, Soft Robotics, (2024). [To be Submitted]

Apr. 2024   **Ali KhalilianMotamed Bonab**, Domenico Chiaradia, Antonio Frisoli, and Daniele Leonardis, *A Framework for Modeling, Optimization, and Musculoskeletal Simulation of an Elbow–Wrist Exosuit*, Robotics 13, no. 4 (2024): 60. ↗

Conference Papers

July 2024   **Ali KhalilianMotamed Bonab**, Cristian Camardella, Antonio Frisoli, and Daniele Leonardis, A Direct-drive, Wearable Armband Device to Experiment Combined Continuous and Vibrotactile Haptic Feedback for Guidance in Motor Tasks, Eurohaptics (2024), Lille, France. ↗

Dec 2023   **Ali KhalilianMotamed Bonab**, Daniele Leonardis, Antonio Frisoli, Domenico Chiaradia, *Modeling, Optimization, and Musculoskeletal Simulation of Elbow-Wrist Exosuit*, 21st International Conference on Advanced Robotics (2023), Abu Dhabi, UAE. ↗

July 2016   **Ali KhalilianMotamed Bonab**, Jafar Keighobadi, *Automatic Self-Guidance and Control of Satellites in Orbit*, International Conference on Research in Science and Engineering (2016), Istanbul University, Istanbul, Turkey. ✳ [Published in Persian]

May 2016   **Ali KhalilianMotamed Bonab**, *Checking the Number and Ordering of Elements in Modal Analysis of Aircraft Wing (NACA 0012) Finite Element Method*, International Congress on Engineering Innovation and Technology Development (2016), University of Tabriz, Tabriz, Iran. ✳ [Published in Persian]

Dec. 2015   **Ali KhalilianMotamed Bonab**, *Identifying and Comparing the Method of Multidisciplinary Design Optimization and its Application in Aerospace Vehicles*, International Conference of Science and Engineering (2015), Dubai, UAE. ✳ [Published in Persian]

Peer Review Experience

For detailed information and verification, please visit my profile on Web of Science ↗.

- IEEE Haptics Symposium (HAPTICS),
- IEEE International Conference on Robotics and Automation (ICRA),
- IEEE International Conference on Robot and Human Interactive Communication,
- IEEE Transactions on Haptics,
- IEEE Robotics and Automation Letters.

RESEARCH PROJECTS

Ph.D. Projects

2022-Present | Development and Experimental Validation of Hybrid Soft-Rigid Elbow Exosuit ◼◀
Developed a lightweight, tendon-driven hybrid exosuit combining soft and rigid components to improve power transfer, stability, and control bandwidth, while ensuring user comfort. Key innovations include a theoretical foundation with a lumped-parameter model, a dual-cabling system for optimized force distribution, a compliant interface to reduce energy loss, and elevated anchor points for efficient power application throughout arm movements. This project is a part of Tuscany Health Ecosystem. ↗

2023-Present | Development of a Wearable Haptic Armband Device Providing Motor Guidance .
Designed a wearable haptic armband with direct-drive actuation and a soft belt interface to provide cleaner, low-intensity linear feedback. Supporting two degrees of freedom, the device combines linear and vibrotactile feedback modalities to enhance motor guidance. This project is part of the European SUN-XR Project. ↗

2022-2023 | Design, Optimization and Musculoskeletal Simulation of Elbow-Wrist Exosuit.

> Developed an elbow-wrist exosuit model and optimized the anchor point parameters through the model of the exosuit and human arm. The optimized exosuit performance was assessed through modeling and attaching it to a musculoskeletal model of a human arm. The optimized exosuit demonstrated a significant improvement in the muscular activities of arm muscles while lifting a weight.

Research Fellowship Projects

2023-2024 | **Design of autonomous vehicles for robotic inspection**
Research fellowship project.
Details of the project is available in Call Link.

2022-2022 | **Manual handling of loads assisted with exoskeletons - Exosuit**
Research fellowship project.
Details of the project is available in Call Link.

M.Sc. Projects

2018-2021 | **Simulation Based Multi-criteria Optimization of Exoskeletons to Reduce Metabolic Cost and Improve Energy Efficiency.** 📹
Master of Science Thesis Project

2020-2021 | **Human-in-the-loop Control and Experimental Verification of a Tethered Hip Exoskeleton.** 📹
Conducted human-subject experiments with a tethered hip exoskeleton with self-alignment properties to reduce device interference with the subjects' gait cycle. Developed human-in-the-loop controllers based on simulation-based optimizations.

2019-2021 | **Human Subjects Evaluation of Simulation-Based Optimized Profiles on Metabolic Cost of Loaded and Unloaded Walking.** 📹
Developed human-in-the-loop control strategies based on simulation-based profiles and scaled biological trajectories and tested several experimental hypotheses the verify the effectiveness of the simulation-based optimized profiles using an untethered hip-knee exoskeleton. Studied the effect of assistance profiles on the kinematics, dynamics, and muscular activation of subjects.

2019-2022 | **Assessing and Multi-criteria Comparison of Haptic Displays Z-width with Electrical Fractional-Order and Integer-Order Damping.**
Proposed a new approach to increase the passive impedance range of a haptic display through the use of fractional order damping and its analog realization. Conducted a multi-criteria comparison between a haptic display with fractional-order and integer-order additional dynamics.

2021-2022 | **Developing and Evaluating a Spherical Haptic Robot, and its Real-Time Implementation.**
Developed a spherical 3 DoF haptic interface. Derived kinematics and dynamics of the robot. Developed interactive controllers for the robot for educational use.

2019-2022 | **Developing and Evaluating a Model-Based based Controllers for Ballbot Robot.**
Developed a ballbot robot and derived its dynamics and implemented model-based optimal controllers (i.e. LQR, iLQR) in real-time to test the performance of controllers.

PATENTS

June 2018		
	Inventors	Ali KhalilianMotamed Bonab, Prof. Hasan Biglari
	Title	Firefighter Hexarotor with High Pressure Capsule and with Controllable Stands and Arms
	Contributions	Designed a novel drone independent from the water source by carrying a custom-designed composite-based fire extinguisher. Developed a novel algorithm and designed a mechanism to change the length of drone arms while keeping the motors provided moment constant to access inaccessible spaces. Proposed new stands for landing the drone in rough terrains.
	Registration	State Organization for Registration of Deeds & Real Estates, Iran, Registration No: 028919

Skills

Computer Skills

	Programming	MATLAB, Python, C\C++, SPSS, git
	Dynamics & Control	Autolev (MotionGenesis), Simulink
	Mechanical Design & Analysis	Fusion 360, Catia, SolidWorks, Creo, Ansys, Comsol
	Electrical Design & Analysis	LTspice, Eagle
	Operating System	Windows, Linux Ubuntu ✸
	Biomechanics	OpenSim/Moco, XSens Motion Analysis System
	Editing	LaTeX, Adobe Illustrator, Adobe Premiere, Adobe Photoshop, Visio
Hardware	*Real-time Control*	Embedded Real-Time Control, Quanser, Simulink Real-Time Control, Beckhoff EtherCAT Control Modules, Speedgoat
	Microcontrollers	ESP32, Teensy 4.0/4.1, Arduino
	Sensors	Inertial Measurement Units, Force/Torque Sensors, Absolute Encoders, Optical Navigation Sensor
	Biomedical Sensors	CORTEX Spiroergometry, DELSYS sEMG Sensors, Vicon Motion Capture System, Xsens IMUs
	3D printers	Makerbot, Ultimaker 3, Markforged Mark Two, Sinterit Lisa
Language	*Fluent*	English, Turkish
	Native/National	Azerbaijani, Persian
	Basic	Arabic, Italian

Teaching Experience

Spring 2019-2020 **Spring 2020-2021**	*Course* *Duties* *Instructor*	Teaching Assistant of Introduction to Robotics Course. Holding weekly recitations, office hours, and grading homework and project. Prof. Volkan Patoglu
Fall 2020-2021	*Course* *Duties* *Instructor*	Teaching Assistant of Analysis and Synthesis of Mechanisms. Holding weekly recitations, office hours, and grading projects and homework. Prof. Volkan Patoglu
Summer 2018-2019 **Spring 2019-2020**	*Course* *Duties* *Instructor*	Teaching Assistant of Systems Modeling & Control Course. Holding weekly recitations, office hours, proctoring exams, and grading Homework and project. Prof. Kursat sendur
Fall 2018-2019 **Fall 2019-2020** **Summer 2019-2020**	*Course* *Duties* *Instructor*	Teaching Assistant of Mechanics Course. Holding weekly recitations, office hours, proctoring, and grading exams, preparing, assigning and grading weekly homework. Prof. Ali Kosar
Fall 2018-2019	*Course* *Duties* *Instructor:*	Teaching Assistant of Control Systems Design Course. Holding weekly recitations, laboratories, office hours, grading exams, and proctoring. Prof. Ahmet Onat.

SPRING 2018-2019	*Course*	Teaching Assistant of Academic Communication Sessions.
	Duties	Checking academic manuscripts of undergraduate students.
	Instructor	Prof. Daniel Lee Calvey
SUMMER 2017-2018	*Course*	Teaching Assistant of Linear Algebra Course.
	Duties	Holding weekly recitations, office hours, proctoring and grading Exams.
	Instructor	Invited Instructor
SPRING 2017-2018	*Course*	Teaching Assistant of Introduction to Finite Element Method.
	Duties	Holding office hours, proctoring exams, grading homework
	Instructor	Prof. Gullu Kiziltas

ACHIEVEMENT

MAY 2023	Research Scholarship On Design of Autonomous Vehicles for Robotic Inspection of Railroads, Administered over nine months.
OCT. 2022	Ranked First in Perceptual Robotics Curricula in Emerging Digital Technologies Ph.D. program Admission and Ranked Third in Emerging Digital Technologies Ph.D. program Admission. ✸
OCT. 2022	Scuola Superiore Sant'Anna Full Scholarship, Monthly stipend, Tuition exemption, Research funds, Administered over three years.
JULY 2022	Research Grant On Manual handling of Loads Assisted with Exoskeletons -Exosuits, Administered over three months.
SEP. 2020	The Scientific and Technological Research Council of Turkey (TUBITAK) Scholarship, Monthly stipend, Administered over two semesters.
JAN. 2018	Sabanci University Deans Full Scholarship, Full tuition fee exemption, Monthly stipend, and Dormitory support, Administered over five semesters. ✸
OCT. 2016	Student Membership in the Iranian Society of Mechanical Engineers.
MAY 2016	Proposal Accepted as Best Ideas, In International Congress on Engineering Innovation and Technology Development, Tabriz University, Tabriz, Iran.
MAY 2014	Proposal Accepted as Chosen Ideas, First Best Idea Festival of University of Tabriz.
JUNE 2013	Ranked in Top 2% Among more than 250000 participants of the whole country, University Entrance Exam, NOET, Iran.
MAY 2012	Ranked First in Provincial Olympiad in Computer Science. ✸
MAY 2011	Ranked Second in Provincial Olympiad in Mathematics.
MAY 2011	Ranked First and Awarded Medal of Honor in Tolu-e-Esteghlal-Elmi National Festival. ✸

EDUCATION AND PROFESSIONAL DEVELOPMENT

Summer Schools and Professional Development

SUMMER 2023	**Summer School on Neurorehabilitation** ✸
Organizer	Shirley Ryan Abilitylab, Imperial College London, Hospital Los Madroños
Location	Baiona, Spain
Duration	June 11–16, 2023

SUMMER 2023	**From minimally invasive surgery to nanorobotics. A voyage in the field of intervention robotics** ✸
Organizer	BioRobotics Institute, Scuola Superiore Sant'Anna
Location	Pisa, Italy
Duration	June 5–9, 2023

Selected Courses

M.Sc. Courses	Force Control and Bilateral Teleoperation, Advanced Bilateral Teleoperation, Introduction to Robotics, Real-Time Systems Design, Machine Learning, Random Process.
B.Sc. Courses	Dynamics of Machinery, Dynamics, Mechanical Vibration, Automatic Control, Numerical Methods, Computer Programming, Fundamentals of Electrical Engineering.
Online Courses	Interfacing with the Arduino ✸, Bayesian Statistics: From Concept to Data Analysis ✸, Modern Control, Optimal Control, Analysis of Variance.

Selected Course Projects

- Tuning LQR controller of a Ballbot system using Bayesian Optimization,
- Evaluating and Extending Z-Width of a Haptic Device using Different Differentiators,
- Evaluating Z-Width of a Haptic Device using Algebraic Numerical Differentiators,
- Design and Development of Kalman Filter for Position Estimation of a Ballbot System,
- Design and Development of Extended Kalman Filter for Differential Derive Robot.

INDUSTRIAL EXPERIENCE

2017-2018	AZERBAIJAN SMART STRUCTURE DEVELOPMENT KNOWLEDGE-BASED COMPANY,
Role	Director and Counselor of Patent Edition and Submission team and Member of R&D, Tabriz, Iran. ✸
2014-2015	JAVID STEEL COMPANY,
Role	Assistance of Engineer at Turning workshop, Bonab, Iran. ✸

References

Prof. Antonio Frisoli

Title	Professor
Address	Institute of Mechanical Intelligence, Scuola Superiore Sant'Anna, Pisa, Italy
Email	antonio.frisoli@santannapisa.it
Website	

Prof. Domenico Chiaradia

Title	Assistant Professor
Address	Institute of Mechanical Intelligence, Scuola Superiore Sant'Anna, Pisa, Italy
Email	domenico.chiaradia@santannapisa.it
Website	

Prof. Daniele Leonardis

Title	Assistant Professor
Address	Institute of Mechanical Intelligence, Scuola Superiore Sant'Anna, Pisa, Italy
Email	daniele.leonardis@santannapisa.it
Website	

Prof. Volkan Patoglu

Title	Professor
Address	Faculty of Natural Science and Engineering, Sabanci University, Istanbul, Turkey
Email	volkan.patoglu@sabanciuniv.edu
Website	