Siamak Faal

Robotics Engineer and Scientist

Highly motivated applied scientist with demonstrated success in developing and implementing technologies and solutions in robotics, mechatronics, control, and optimization. Expert at design and implementation of novel algorithms to variety of advanced robotic and mechatronic systems. Proficient in orchestrating teams to prototype, build, test, and maintain hardware and software solutions. Passionate about conducting comprehensive research in collaborative environments.

Education

- Ph.D. in Robotics Engineering | Worcester Polytechnic Institute, MA, 2018
- Master of Science in Applied Mathematics | Worcester Polytechnic Institute, MA, 2019
- Master of Science in Mechatronics | Sharif University of Technology, Iran, 2012
- Bachelor of Science in Mechanical Engineering | Sharif University of Technology, Iran, 2009

Areas of Expertise

- Optimization and Control
- Motion and Trajectory Planning and Optimization
- AI, Machine Learning and Deep Learning
- Robotic, Mechatronic and Automation
- Image Processing and Computer Vision

- PDE, ODE and Numerical Analysis
- Simulation and Modeling
- Systems Engineering

Technical Proficiency

Programming C; C++; Python; MATLAB; JavaScript; GO; PHP; BASH; **Scientific Computing** MATLAB; SciPy; NumPy; CUDA; OpenCL; **Embedded Systems** RTOS; Embedded C; Embedded Python; Altium Designer; Proteus Design Suite; **Robotics** ROS2; Simscape Multibody; MuJoCo; Gazebo; **ML, DL and CV** TensorFlow; PyTorch; OpenCV (Python & C++); MATLAB **Computer Aided Design (CAD)** SolidWorks; AutoCAD; Creo; **Markup Language** TeX; LaTeX; HTML; CSS;

Professional Experience

Applied Scientist, Kodama, CA, 2023

Designing and implementing motion planning algorithms for autonomous forestry machinery. Creating models, performing simulations and data analysis, and providing optimized solutions for various tasks and assignments involved in forestry.

Robotic Applied Scientist, Amazon, WA, 2022

Formulated and implemented solutions to problems in motion planning, optimal storage allocation and damage reduction for a robotic consolidation system to be utilized at fulfilment centers. - Reduced consolidation cycle time from 12.8 s to 1.8 s (~70% decrease in time; faster than 2 s original design criterion) by formulating, solving, and implementing an optimal control solution in less than 2 month of tenure.

Computational Scientist, Worcester Polytechnic Institute, MA, 2019 − 2022

Managed a diverse team of engineers and artists on creating and integrating interactive learning experiences for various courses in ME, ECE, CS, MA and PH. Guided faculty and graduate students on the development of simulations and computational approaches to support institute's multifaceted research. - Developed a remote code editor and compiler with a full API support, embeddable in Canvas, to provide interactive examples for languages such as C++, HTML, LaTeX, Octave, and Python.
- Initiated and supervised the development of asynchronous online software trainings and automated certifications.

Adjunct Professor, Worcester Polytechnic Institute, MA, 2019 − 2022

Planed, organized, and delivered engaging graduate and undergraduate lectures on Control, Robotics, AI, Machine Learning, Differential Equations, Linear Algebra, and Calculus. Created supplementary materials and volunteered extra hours to support underperforming learners towards achieving desired grades. - Coordinated faculty to redesign course material, delivery methods and software applications used for the Calculus labs that led to %72 increase in student engagement and mastery of the subject (reflect through grades and reviews). - Customized course materials with engaging real-world examples to encourage project-based learning.

Postdoctoral Researcher, Department of Mathematical Sciences, Worcester Polytechnic Institute, MA, 2019

Conducted research on numerical analysis of partial differential equations and convolution neural networks. Organized and involved in a study group composed

of faculty, post docs and students, with focus on the theory and practice of deep learning. - Formulated a stable and robust Newton's iterations to solve the finite element problem for Cahn-Hilliard Equations with a logarithmic nonlinear potential function. - Developed MATLAB and C++ applications to solve the finite element problem with BPX preconditioning.

Academic Research

- Developed and implemented optimal BPX preconditioner for Cahn-Hilliard equations with logarithmic potential function.
- Studied the effect of input saturation in nonlinear closed-loop systems, and developed feedback-planning schemes to synthesize controller functions for nonlinear systems subjected to input limitations (Ph.D. thesis).
- Formulated and experimentally validated a decentralized method to achieve collective object manipulation with swarm robotic systems using custom designed and fabricated holonomic drive robots.
- Formulated Jacobian based controllers for underactuated systems, in particular, unmanned aerial vehicles.

Affiliations & Leadership

- President: Lecture, A Multidisciplinary Learning & Teaching Organization, Worcester Polytechnic Institute, MA, 2015 – 2018
- Chair: Iranian Students Association, Worcester Polytechnic Institute, Worcester, MA, 2016 – 2017
- Director: Robotic Group, Sharif University of Technology, International campus, Kish, Iran, 2007 – 2012
- Director: Mechatronic Workshop, Sharif University of Technology, International campus, Kish, Iran, 2009

Academic & Community Activities

Manuscript Peer Reviews

- IEEE Conference – Automation Science & Engineering; International Symposium on Assembly & Manufacturing (CASE & ISAM)
- IEEE Conference – Technologies for Practical Robot Applications (TePRA)
- IEEE International Conference – Robotics and Automation (ICRA)
- IEEE Transactions – Mechatronics
- IEEE Transactions – Robotics
- Springer Intelligent Service – Robotics

Educational Outreach

- Engineering Software (Frontiers II), Frontiers Summer STEM Residential Camp, Worcester Polytechnic Institute, MA, 2017/2018

- Mechanical Engineering (Frontiers I), Frontiers Summer STEM Residential Camp, Worcester Polytechnic Institute, MA, 2017

Professional Development

Certificates

- Individual Development Plan, Worcester Polytechnic Institute, MA, 2017
- Research Communication Series, Worcester Polytechnic Institute, MA, 2017 ### Courses
- Faculty Institute for Online Teaching, Worcester Polytechnic Institute, 2020
- Project management Online Course, University of Adelaide, edX.org, 2016
- Presenting Data & Information Course, Edward Tufte, Boston, MA, 2015

Awards & Honors

- Best Conference Paper Award (ABB), 12th IEEE International Conference on Automation Science & Engineering (CASE), 2016
- Teaching Assistant of the Year Award, Worcester Polytechnic Institute, 2015
- Ranked 2nd among all Mechatronics M.S. Students, Sharif University of Technology, Class of 2012
- Ranked 2nd among all Mechatronics B.S. Students, Sharif University of Technology, Class of 2009

Publications

- S. Faal, A. Powell, M. Sarkis, "Robust BPX Solver for Cahn–Hilliard Equations" 2022 In: Brenner, S.C., Chung, E., Klawonn, A., Kwok, F., Xu, J., Zou, J. (eds) Domain Decomposition Methods in Science and Engineering XXVI. Lecture Notes in Computational Science and Engineering, vol 145. Springer, Cham.
- S. T. Kalat, S. Faal, "A Feedback-Planning Scheme to Synthesize Control Functions", 2020 American Control Conference (ACC), 1743-1748.
- S. T. Kalat, M. Farzad, S. Faal, "A computationally efficient approach to decentralized routing of swarms via a family of pre-fractal curves", 2019 American Control Conference (ACC), 1482-1487.
- L. Prignano, S. Faal, A. Hera, R. E. Dempski, "An optimized and automated approach to quantifying channelrhodopsin photocurrent kinetics", Analytical Biochemistry, Volume 566, 2019, Pages 160-167.

- S. T. Kalat, S. Faal, C. D. Onal, "A decentralized communication free force distribution method with application to collective object manipulation", ASME Journal of dynamic systems, measurement, and control, 2018.
- S. Faal, S. T. Kalat, C. D. Onal, "Decentralized obstacle avoidance in collective object manipulation", NASA/ESA Conference on Adaptive

Hardware and Systems (AHS 2017), California, 2017.

- S. T. Kalat, S. Faal, C. D. Onal, "Scalable cooperative impedance control of an object via a decentralized force control approach for swarm systems", American Control Conference (ACC), Seattle, Washington, 2017.

- S. Faal, C. D. Onal, "Regionally Growing Random Trees: a synergistic motion planning and control algorithm for dynamic systems", International Conference on Automation Science and Engineering, (CASE), Fort Worth, Texas, 2016 [received the Best Conference Paper Award].
- S. Faal, F. Chen, W. Tao, S. T. Kalat, P. Razavi, V. Eshaghian, C. D. Onal, "Design, fabrication, experimental analysis, and test flight of an origami-based fixed-wing aerial vehicle: µPlane", ASME 40th Mechanisms and Robotics Conference, Charlotte, North Carolina, 2016.
- S. Faal, S. T. Kalat, C. D. Onal, "Towards collective manipulation without inter-agent communication", Intelligent Robotics and Multi-Agent Systems (IRMAS), Pisa, Italy, 2016.
- S. T. Kalat, S. Faal, U. Celik, C. D. Onal, "Tribot: a minimally actuated accessible holonomic hexapedal platform", IEEE/RSJ International Conference on Intelligent Robots and Systems, Hamburg, Germany, 2015.

- S. Faal, F. Chen, W. Tao, M. Agheli, S. T. Kalat, C. D. Onal, "Hierarchical kinematic design of foldable hexapedal locomotion platforms", ASME Journal of Mechanisms and Robotics, JMR 3, no. 4L3 (2015): 1.

- M. Agheli, S. Faal, F. Chen, H. Gong, and C. D. Onal, "Design and fabrication of a foldable hexapod robot towards experimental swarm applications", International Conference on Robotics and Automation (ICRA), 2014.