

## Education

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### Doctor of Philosophy

Robotics Engineering  
Worcester Polytechnic Institute  
GPA: 4.00/4.00

Aug. 2012 – May. 2018 (expected)  
Worcester, MA, USA

**Title:** “A Synergistic Path Planning and Control of Dynamic Systems”

**Advisor:** Prof. Cagdas D. Onal

This research focuses on a combined path planning and control algorithm that utilizes system dynamics to perform maneuvers that are not achievable with conventional controllers. The algorithm is composed of a search and an execution phases. The goal of the search phase is to find a possible path between the initial and the goal state of the system by considering all the limitations imposed on the system dynamics and the differential constraints. The discovered path executed by a controller that guarantees the convergence of the system trajectory to the desired path in the presence of external disturbances and un-modeled dynamics. Although they are explained in a hierarchical order, the two phases can be executed simultaneously to improve or find better trajectories or control actions. The proposed algorithm can be utilized in different areas that require control or planning of a dynamic system. Examples include, but not limited to: Highly aggressive maneuvers in aerial vehicles such as bird-like purging, take-off and obstacle avoidance; Harvesting ocean energy to improve the efficiency and maneuverability of the underwater vehicles; Dynamic stability and gait control of legged robots; Protein and RNA folding; Trajectory planning for soft/continuum actuators and manipulators.

### Master of Science

Mechatronics  
Sharif University of Technology, International campus  
GPA: 4.00/4.00

Sep. 2009 – Jan. 2012  
Kish Island, Iran

**Ranked 2<sup>nd</sup>** among all the Mechatronics MSc students in Sharif University of Technology, Int'l campus, class of 2009.

**Title:** “Design and Analysis of a Robotic Duct Cleaning System”

**Advisor:** Prof. Gholamreza Vossoughi

Design and fabrication of a hybrid legged/wheeled duct cleaning robot capable of maneuvering in circular and rectangular air ducts with any orientation and material. The robot is composed of a hybrid 4 degree of freedom waist mechanism that is attached to two carts. Each cart is equipped with a differential drive wheeled system and four suction cups with adjustable heights. The overall mechanism allows the robot to either climb using an inch worm locomotion pattern or drive through air ducts.

### Bachelor of Science

Mechatronics  
Sharif University of Technology, International campus  
GPA: 4.00/4.00

Sep. 2003 – Jan. 2009  
Kish Island, Iran

**Ranked 2<sup>nd</sup>** among all the Mechatronics BSc students in Sharif University of Technology, Int'l campus, class of 2004.

## Research Interests

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- Modelling and control of dynamic systems
- Nonlinear control and control theory
- Path and motion planning algorithms
- Autonomous systems
- Multi-robot and swarm system
- Legged locomotion and bio-inspired robotics
- Artificial intelligence
- Analytical dynamics
- Embedded system design

## Skills

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### Computer skills

**MATLAB:** Programming, Simulink, SimMechanics, SimHydraulics, Control, Image Processing, Neural Network, Guide, and Fuzzy Logic Toolboxes. (More than 11 years of experience)

Mechanical modelling, analysis and design: **SolidWorks, Creo, ADAMS, V-REP, Working Model, Automation Studio.**

Electrical modelling, analysis and design: **Altium DXP, Proteus, MultiSim, PSpice.**

Programming languages: **C, C++, PYTHON, MATLAB, HTML/CSS, LabVIEW.**

### Language skills

- English: Fluent
- Persian: Native language
- Azerbaijani: Fluent
- Turkish: Fluent

## Awards and Honors

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**Best Conference Paper Award**, sponsored by ABB, 12th IEEE International Conference on Automation Science and Engineering (CASE), 2016

**Teaching Assistant of the Year Award**, Worcester Polytechnic Institute, 2015.

**Ranked 2<sup>nd</sup>** among all the Mechatronics MSc students in Sharif University of Technology, Int'l campus, class of 2009.

**Ranked 2<sup>nd</sup>** among all the Mechatronics BSc students in Sharif University of Technology, Int'l campus, class of 2004.

## Professional experiences

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### Work experiences

#### Instructor and teaching assistant

Academic and Research Computing Group,  
Worcester Polytechnic Institute,

Sep. 2012 – present  
Worcester, MA, USA

Conducting training sessions on MATLAB, SolidWorks and LabVIEW to support the core academic curriculum and research activities; Project consultations for students and faculty in areas related to control, image processing, embedded

system design, mechanism modelling, synthesis and design, analytical and numerical optimization, and computer aided design.

### **Mechatronics system designer**

Research and development group  
Talashgaran Atabak Co.

Oct. 2008 – Aug. 2012  
Zanjan, Iran

Design, prototype fabrication, on-site assembly and debug of the mechatronic products of the company. These projects include, but not limited to: Automated LED based lighting systems, code locks, smart home appliances and sport fields and court facilities.

### **Design engineer**

Logistic and mechanical engineering team  
TAM Iran Khodro Co.

Jun. 2008 – Sep. 2008  
Tehran, Iran,

Analysis and design of a smart conveyer system to continuously convey, store and deliver different parts of a car to the operators and robots that are located near the assembly line.

## **Teaching Experiences**

- **“MATLAB”**, Instructor, Academic and Research Computing Group, Worcester Polytechnic Institute, Worcester, MA, Sept. 2012 – present, (Instructed over 1000 students on introductory and advanced topics).
- **“Advanced computer aided design”**, Teaching assistant, Worcester Polytechnic Institute, Worcester, MA, Jan. 2015 – Mar. 2015.
- **“Fundamentals of Mechatronics, Analytical Dynamics”**, Teaching assistant, Sharif University of Technology - International campus, spring 2011.
- **“Engineering Dynamics”**, Teaching assistant, Sharif University of Technology - International campus, fall 2010
- **“Robotic, Fundamentals of Mechatronics, Electrical Machines, Microprocessors”**, Teaching assistant, Sharif University of Technology - International campus, spring 2010.
- **“Mechatronic Systems”**, Laboratory assistant, Sharif University of Technology – International campus, fall 2009.
- **“Mechatronic Systems, Microprocessors, Machine and Mechanisms, Heat Transfer”**, Teaching assistant, Sharif University of Technology - International campus, fall 2009.
- **“Computer Structure and Language”**, Teaching assistant, Sharif University of Technology - International campus, summer 2008.

## **Research Experiences**

- Synergic Path Planning and Control of Dynamic Systems in State-Space (PhD thesis).
- Collective manipulation with swarm of robots without inter-agent Communication (PhD research).
- Design and control of a micro tilt rotor robotic platform (PhD research).

- Design and gait optimization of a foldable mini hexapod robot for swarm applications (PhD research).
- Design and analysis of a robotic duct cleaning system (MS thesis).
- Design and fabrication of a remotely operated planetary rover with an onboard manipulator for exploring uneven terrain (MS research)
- Design and fabrication of a codelock system with remote privilege control capability (BS major project).
- Design and fabrication of a line follower robot with a manipulator arm (BS research).
- Design a 6DOF manipulator for parallel-mobile robot (BS research).
- Design of a robotic electro-pneumatic gripper with grasp force feedback and control (BS research).
- Developing and application for generalized synthesis of four-bar linkages with differential-evolution optimization method in MATLAB (BS research).

## Publications

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**S. G. 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 (to be published)

S. T. Kalat, **S. G. 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. G. 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. G. 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:  $\mu$ Plane”, ASME 40th Mechanisms and Robotics Conference, Charlotte, North Carolina, 2016 (to be published)

**S. G. 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. G. 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. G. 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. G. 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

M. Azimpour Kivi, R. Azmi, **S. G. Faal**, “Artificial Immune Systems (AIS) For Classification And Its Application To Anomaly Detection”, 4<sup>th</sup> Iran Data mining Conference, 2010

## Extracurricular Activities

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**Founder and Director of Lecture**, A multidisciplinary learning and teaching environment, Worcester Polytechnic Institute (2015 to present)

**Public relations chair for ISA (Iranian Students Association) at WPI**, Worcester Polytechnic Institute (2016 – 2017)

**Director of robotic group**, Sharif University of Technology, International campus (2007 to 2012)

**Director of mechatronic workshops**, Sharif University of Technology - International campus (Fall 2009)

## References

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**Prof. Gholamreza Vossoughi**

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