Barzin Moridian
M.Sc.

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RESEARCH INTERESTS

Dynamic Systems, Controls, Robotics, Autonomous Systems, Machine Learning and Artificial Intelligence, Image Processing, Mechanism Design

EDUCATION

2014 **M.Sc. Mechanical Engineering**
Michigan Technological University, Houghton, MI
Thesis: Autonomous mobile power distribution systems
Advisor: Nina Mahmoudian

2012 **B.Sc. Aerospace Engineering**
Amirkabir University of Technology (Tehran Polytechnic), Tehran, Iran

PROFESSIONAL EXPERIENCE

2015 - Present **Research Engineer** and **Lab manager**
Nonlinear and Autonomous Systems Lab (NASLab), Michigan Tech, Houghton, MI
- Development of path planning method for unknown and unstructured environments
  - Developed a triangulation based method that uses Lidar (Laser Range Finder) readings to locate obstacles, generate collision free path, and keep the robot within safe distance from obstacles in the environment.
  - Simulated the developed method in Matlab. Validation was done by coding the method in Python to run in ROS (Robotic Operating System) on ClearPath's Husky ground robots.
- Development of collision avoidance system for dynamic (moving) obstacles to eliminate both head-on collision and side collision
  - This method monitors the changes in environment and calculates a safe moving velocity for ground robots.
  - Validated the method by deploying it on multiple ground robots that successfully dodged each other and additional moving obstacles while the robots were navigating autonomously to their predefined destinations.
- Software development for planning persistent robotic missions
  - Developed a system capable of generating optimized trajectories for team of robots using genetic algorithm method to perform area coverage missions with minimum time or minimum travel distance.
  - Location optimization of robotic charging station based on robots' trajectories.
  - Combined optimization of trajectories of working robots, trajectories of service robots, timing of charge attempts, and location of charging stations using Nash's equilibrium method, genetic algorithm, and mixed-integer linear programming
- Development of Autonomous Mobile Microgrid
  - The developed system establishes a microgrid by managing a group of robots to carry electrical power systems, navigate to an area, establish electrical connection between themselves and also power loads, powering up the loads in the area, and maintaining a desired voltage level.
  - Designed and fabricated a cabling solution to be installed on robots which enables

them to establish wired electrical connections between two electrical units.
- ○ The system was tested and validated on full-size robots (Huskies from ClearPath).
- Development of a reference point following algorithm for navigation of autonomous ground robots in narrow environments
  - ○ The developed method incorporates two PID controllers in addition to a fuzzy logic rule to minimize the lateral error while moving on any given reference path, such as noncontinuous paths.
  - ○ Tested and validated on autonomous Husky ground robots and achieved improvements in lateral error, overshoot, and time of reaching end of paths.
- Autonomous Micro Aerial Vehicles
  - ○ System setup and controller tuning for a 6-rotor multicopter (hexacopter).
  - ○ Developed an indoor navigation system to move the Aerial Vehicle on a given reference path autonomously.
  - ○ Development of automatic takeoff and landing algorithms
- Design and fabrication of robot-friendly, AC/DC electrical connectors
  - ○ Designed and 3D printed a self-aligning conical connection that has 5 conductors to support DC, AC, and three-phase AC current types.
  - ○ The designed system compensates for about one inch axial offset and establishes successful connections independent of rotation of the parts.
- Development of Linux driver and small footprint messaging layout for Qualisys motion capture camera system for indoor localization
- Setup of multi-user/multi-robot communication over TCP/IP for lab tests.
- Technical support of Autonomous Underwater Glider project

2012 - 2014   **Robotics Researcher** and **Team Lead** of Autonomous Ground Vehicles group
NASLab, Michigan Tech, Houghton, MI
- Autonomous Tracked Vehicle
  - ○ Autonomizing a full-sized (700 lbs) tracked ground vehicle.
  - ○ Setup and configuration of National Instruments single board RIO.
  - ○ Integration of RoboteQ motor controller for actuation control of DC motors.
  - ○ Designed and modeled mechanical components for mounting different mechanisms, sensors, and actuators on robots(SolidWorks).
  - ○ Integration of Sonar, infrared, and Lidar sensors.
- Autonomous indoor navigation of small ground robots
  - ○ Developed path planning and path tracking algorithms in LabVIEW for National Instrument's Dani robots using a single infrared sensor.
  - ○ Tested and validated the system by performing path following and dead reckoning.
- Proof of concept for autonomous mobile microgrid.
  - ○ Small-scale prototype of autonomous mobile microgrids using Dani robots from National Instruments.
- Developed task schedules, timelines, deadlines and documentation
- Assigned tasks according to team member strengths, skills, and abilities
- Coordinate and edit project technical report and oral presentation made to corporate, professional and academic audience

2012 - 2013   **Controls Researcher**
Energy Mechatronics Laboratory, Michigan Tech, Houghton, MI
- Developed software system for real-time state/parameter estimation
  - ○ Derived mathematical model of HVAC system of building based on RC circuit method.
  - ○ Estimation of building's thermodynamics parameters using numerical optimization methods based on data gathered from building sensors and setpoints/timing of building heaters.
  - ○ Implemented and compared both Extended and Unscented Kalman Filters for simultaneous estimation of thermal states and building thermodynamics parameters in real-time.

2009 - 2009   **Controls and Design Engineering Intern**

Zav Co., Tehran, Iran
- Programmed and tested HVAC controllers (Siemens Controllers).
- Calculated refrigeration systems load based on desired operation states and specification and design of the refrigeration room.
- Performed market analysis for emerging technologies.
- 3D modeling of parts and their composition to facilitate production process (SolidWorks).

PUBLICATION

1. B. Moridian, N. Beyers, N. Mahmoudian, "Self-aligning Robotic AC/DC Connector". (In preparation)
2. B. Lee, B. Moridian, N. Mahmoudian, "Persistent Area Coverage Mission Planning using Static Charging Stations", in International Conference on Intelligent Robots and Systems. IEEE, 2016. (In preparation)
3. Barzin Moridian, Nina Mahmoudian, Wayne W. Weaver, Rush D. Robinett, "Post-Disaster Electric Power Recovery Using Autonomous Vehicles", In Transaction on Automation Science and Engineering Special Issue on Safety, Security, and Rescue Robotics. IEEE, 2017. (Accepted)
4. B. Moridian, N. Mahmoudian, W. W. Weaver, and R. D. Robinett, "Design of mobile microgrids hierarchy for power distribution," in ASME 2015 Dynamic Systems and Control Conference. American Society of Mechanical Engineers, 2015
5. B. Moridian, N. Mahmoudian, W. W. Weaver, and R. D. Robinett, "Robotic power distribution system for post-disaster operations," in International Symposium on Safety, Security, and Rescue Robotics. IEEE, 2015
6. B. Moridian, D. Bennett, N. Mahmoudian, W. Weaver, and R. D. Robinett, "Autonomous power distribution system," in International Federation of Automatic Control. World Congress (19th). International Federation of Automatic Control, 2014.
7. Mehdi Maasoumy, Barzin Moridian, Meysam Razmara, Mahdi Shahbakhti, and Alberto Sangiovanni-Vincentelli. "Online simultaneous state estimation and parameter adaptation for building predictive control." In ASME 2013 Dynamic Systems and Control Conference. American Society of Mechanical Engineers, 2013.
8. Ficanha, Evandro M., Mohammad Rastgaar, Barzin Moridian, and Nina Mahmoudian. "Ankle Angles during Step Turn and Straight Walk: implications for the design of a steerable ankle-foot Prosthetic Robot." In ASME 2013 Dynamic Systems and Control Conference. American Society of Mechanical Engineers, 2013.

OTHER PROJECTS

- Structure-free, self-configuring neural networks (in progress)
- 6 DOF multicopter aerial vehicle design without roll and pitch constraints (in progress)
- Object Tracking based on Color Specifications using Camera
  https://github.com/BarzinM/ImageProcessing
  https://www.youtube.com/watch?v=2XXtT_zAwis
- Web Data Extraction using Document Object Model Parsing
  https://github.com/BarzinM/turtle-swap
- Development of Linux Driver for UM7 Inertia Measurement Unit
  https://github.com/BarzinM/Arctic-Desmodus
- Simulation and Control System Development for 6-rotor Multicopters (Hexacopter)
  https://github.com/BarzinM/UAV

TEACHING AND MENTORING EXPERIENCE

Instructor of Dynamic Systems and Controls lab – 32 students

- Taught modern controls theories to graduate and undergraduate students in a lab environment with implementation of spring loaded multiple interconnected cart system and two reservoir hydraulic system
- Guided them through system identification, dynamic system modeling, control system design, simulation, and control parameter tuning based on simulation and experiment
- Addressed learner issues such as language and computer skill

Instructor of Manufacturing Precision and Metrology – 39 students
- Taught different metrology methods to graduate and undergraduate students in a lab environment using the following tools: Cobra Laser Profilometer with DRS8000 scan head, S3P Perth-o-meter, Nikon Autocollimator, Tolyrond, Brown & Sharp MicroVal CMM
- Guided students through operating precision devices, error minimization practices, and analysis of measurement based on statistical methods

Mentoring graduate level Special Topics and volunteer students
- Sumeet Chhawri: Design and prototype of high-penetration, mid-range (20"-30") inductive power transfer system.
- Nathan Beyers: Simulation of ground robots in multiagent, outdoor scenarios.
- Kirk D'Souza: Building a 3D printer (XYZ type).
- Xiang Zhou: Mathematical modelling of Li-Po battery aging behaviour.
- Lohita Rani Chamarti: Lyapunov based cooperative control of multiagent systems.
- Pranav Salunke: Design and control of self-balancing wheeled system (Segway type).
- Anudeep Reddy Karra: Highly energy efficient control of autonomous underwater gliders.
- Nithin Teja Kondipati: Discrete modelling of Hexacopters and simulation of PID controllers for adjusting altitude, attitude, heading, and position.

PROFESSIONAL SERVICE

- Newsletter editor of IEEE Cloud Computing Community
- eMentor in IEEE MentorCenter (IEEE Collabratec™ since April 2016)
- Team Mentor in NSF I-Corps Site program
- Session Chair of Multiagent Network Systems session in ASME 2015 Dynamic Systems and Controls Conference (DSCC 2015)
- Conference reviewer of IEEE Robots and Systems (IROS 2016)
- Journal reviewer of IEEE Transaction on Automation Science and Engineering
- Journal reviewer of IEEE Transactions on Control of Network Systems
- Conference reviewer of IEEE International Conference on Robotics and Automation (ICRA)
- Judge in Michigan Tech's Design Expo 2016

COMMUNITY SERVICE

- Steering committee member of Keweenaw Young Professionals (non-profit organization)
- Judge in Keweenaw Community Spark Plug Award to recognize local businesses and individuals

PROFESSIONAL SOCIETIES

- IEEE Robotics and Automation Society
- IEEE Cloud Computing
- IEEE Transportation Electrification Community
- American Society of Mechanical Engineering (ASME)
- Michigan Science Teachers Association (MSTA)

AWARDS AND CERTIFICATES

- Innovation Corps (I-Corps) site program certificate from National Science Foundation and

Michigan Technological University
- Entrepreneurship certificate from SmartZone Business Incubator
- Best Student Paper Award Finalist in ASME 2013 Dynamic Systems and Control Conference
- Certified LabVIEW Associate Developer (CLAD)
- 582nd among over 450,000 participants (top 0.13%) in the National Undergraduate University Entrance Exam