# Kasra Eshaghi

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## *Education*

*Ph.D. – Mechanical Engineering*

University of Toronto – CIMLab / ASB Lab – Sept. 2018 – Dec. 2023.

- Investigated collaborative-motion control and planning methodologies for robotic swarms with limited onboard sensing capabilities.
- Developed swarm localization and mapping methodologies while considering scalability.
- Designed, fabricated, and programmed a millimeter scale robot for algorithm verification.

*B.A.Sc. – Mechanical Engineering*

University of Toronto – Sept. 2013 – May 2018.

- Specialized in mechatronics and control.

*Relevant Courses*

- Robot motion planning, Mobile robots and perception, Mechatronic principles, Analog and digital electronics, Introduction to machine learning.

## *Robot Software Experience*

*Collaborative-Motion Control Strategies for Robotic Swarms*

- Developed collaborative-motion control strategies for robotic swarms whose members have short-range onboard proximity sensors that prevent them from localizing individually.
- Optimized the developed strategies through path planning and combinatoric optimization to achieve minimum motion control errors.
- Achieved significant improvement in motion control compared to the state-of-the-art.

*Constrained Swarm Motion Planning*

- Developed a motion planning methodology for robotic swarms subject to inter-robot trajectory constraints imposed by collaborative-motion control strategies.
- Formulated and solved relevant sub-problems including the division-of-labor, task-allocation, path-planning, and movement-concurrency to minimize mission execution time.
- Improved mission execution performance by 40% compared to the state-of-the-art.

*Swarm Localization Using Partial Location Data*

- Developed a swarm localization methodology that estimates the position of the robots based on inter-/outer-robot proximity measurements, motion commands, and the map of the environment.
- Devised a clustering function to combine the obtained proximity measurements for swarm topology estimation while considering scalability to large-scale swarms.
- Formulated a weighted least-squares objective to combine the estimated swarm topology with the executed motion commands and the known map of the environment.

## *Robot Hardware Experience*

*mROBerTO 2.0*

- Designed, fabricated, and debugged the mechatronic system of a 20*mm* x 20*mm* robot for swarm studies. This included PCB design for the locomotion, computation, wireless communication, sensing, and power management modules.
- Programmed the libraries for interfacing with the various modules, and the robot control architectures for swarm experiments and algorithm verification.

## *Machine Learning Experience*

*Product Rating Prediction – Amazon Dataset*

- Developed and trained a neural network to predict Amazon product ratings based on reviewer data.
- Pre-processed the data through case-folding, tokenization, lemmatization, stop-word removal, and one-hot encoding.
- Conducted an exploratory analysis to evaluate the dependence of the available textual and contextual data on product ratings.
- Achieved a prediction error 30% better than the competing baseline using a network that considered the reviewers' comments and summaries, and the products' review times and categories. Network included dense, recurrent, and embedding layers, and was tuned through a grid-search.

## *Professional Engineering Experience*

*Mechanical Engineering Assistant*

SciCan Ltd. Department of Research and Development, Toronto, Canada – May 2016 – July 2017.

- Collaborated with engineers, service personnel, and manufacturing staff on the development of a steam autoclave sterilizer for dental applications.
- Studied the venturi vacuum pump initiation problem and designed a fluid distortion mechanism to ensure initiation under all working conditions.
- Designed and fabricated multiple mechatronic systems dedicated to evaluating the vacuum pump, functionality of thermal switches, and hydro-pressure testing the pressure vessels.

## *Leadership Experience*

*Head Teacher Assistant*

University of Toronto, Probability & Statistics / Manufacturing Engineering – Sept. 2020 – May 2023.

- Taught classes of up to 40 students, organized course material, and managed up to eight teacher assistants.

## *Technical Skills*

| *Programming Languages* | *Programming Tools* | *Mechatronics and Design* |
|---|---|---|
| Python, Embedded C, Matlab, Simulink. | TensorFlow, scikit-learn, Pandas, NumPy, Matplotlib, Git, ROS. | PCB design and development, Autodesk EAGLE, SolidWorks. |