S M NAHID MAHMUD

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Education

Purdue University **Aug. 2022 - Current**
Doctor of Philosophy in Aerospace Engineering *West Lafayette, Indiana*

Oklahoma State University (OSU) **Jan. 2019 - May 2021**
Master of Science in Mechanical and Aerospace Engineering *Stillwater, Oklahoma*

Islamic University of Technology (IUT) **Jan. 2012 - Dec. 2015**
Bachelor of Science in Mechanical Engineering *Dhaka, Bangladesh*

Technical Skills

Programming Languages: C, C++, Python, Arduino IDE, Ardupilot.
Web Language: HTML, CSS, JavaScript.
Design Software: Solid Works, Adobe Photoshop, Adobe Illustrator, 3D max.
Simulation software: Ansys, Matlab, Comsol, Netlogo, Webot.
Hardware: Pixhawk, Arduino, Sonar, LCD, GPRS, Bluetooth, Wi-Fi.

Experience

Ross Fellow **Aug. 2022 - Current**
Autonomous & Intelligent Multi-agent Systems Lab, Purdue University *West Lafayette, Indiana*

- Working on the development of safe reinforcement learning algorithms.

Research Engineer **Aug. 2021 - April 2022**
Systems, Cognition, and Control Laboratory, OSU *Stillwater, Oklahoma*

- Working on the development of a local model learning method for deterministic continuous-time nonlinear systems.

Graduate Research Assistant **May 2019 - May 2021**
Systems, Cognition, and Control Laboratory, OSU *Stillwater, Oklahoma*

- Developed two novel Model-Based Reinforcement Learning frameworks for safety-critical nonlinear systems with parametric uncertainties and partial output feedback.

Graduate Teaching Assistant **Jan. 2019 - Aug. 2020**
Mechanical and Aerospace Engineering Department, OSU *Stillwater, Oklahoma*

- Supported 150+ students to have a better understanding of dynamics, and coached four students for a senior design project on autonomous robot for underground excavation.

Adjunct Lecturer **Sep. 2017 - Dec. 2018**
Mechanical Engineering Department, Sonargaon University *Dhaka, Bangladesh*

- Taught 300+ students dynamics and automatic control concepts and administered dynamical modeling simulations.

Administrator and Designer **Feb. 2015 - Dec. 2018**
Moon Engineering Works *Dhaka, Bangladesh*

- Designed and orchestrated the way to build yarn dyeing machines total worth 120k dollars, decreasing the construction cost by 15%. Worked on textile racks designing project worth 100k dollars, reducing the constructing cost by 23%.

Relevant Projects

Safety Aware Navigation | *MATLAB, GPOPS II* **Oct. 2019 - April 2021**

- Developed two novel Model-Based Reinforcement Learning frameworks with parametric uncertainties and partially observable nonlinear systems.
- The frameworks incorporate barrier transformation to guarantee 100 % safe navigation for nonlinear systems.

Minimum Time-to-Climb of a Supersonic Aircraft | *Optimization, MATLAB, GPOPS II* **Sep. 2020 - Dec. 2020**

- Demonstrated two optimal control methods, such as Pontryagin maximum principle (PMP) and pseudospectral method (LQR), on the model of F-4 aircraft. PMP method was better by 21 times in terms of optimizing time.

Incremental quasi-newton method with local superlinear convergence rate | *Python* **March 2020 - May 2020**

- Reconstructed the Incremental quasi-newton (IQN) method and applied IQN to a numerical experiment resulting in the gradient magnitude go to the order of 10^{-8}, significantly lower than algorithms such as Sequence Alignment by Genetic Algorithm (order of 10^{-5}).

Wind Aware Navigation | *POD, Modified A* Star, MATLAB* **May 2019 - Oct. 2019**

- Done feasibility analysis of a novel modified A* star algorithm for trajectory generation using wind characteristics. Conducted Monte-Carlo reachability analysis to validate safety.

Intruder UAVs avoidance using Grey Wolf Algorithm | *Heuristic Optimization, Netlogo* **March'19 - May'19**

- Designed a navigation framework using the Grey Wolf optimization algorithm to avoid intruder UAVs.

Autonomous car collision avoidance using Q-learning | *Reinforcement Learning, MATLAB* **Oct. 2018 - Dec. 2018**

- Implemented Q-Learning to train an autonomous car model to avoid collision while optimizing trajectory. Seventy iterations were needed to learn the offline policy that can guarantee 100 % safe navigation within 1.5m vision.

Development of robots | *SolidWorks, 3D Max, Arduino IDE, PSpice* **Jan. 2013 - Nov. 2015**

- Designed objective-directed 10+ IR sensor arrays, 3+ object grabbers, and necessary circuit boards to construct 7+ line following with obstacle avoidance and/or object grabbing autonomous robots and three object grabbing manual robots using Arduino Platform.

Publications Google Scholar

Accepted Journal Papers

- R. V. Self, M. Abudia, **S. M. N. Mahmud** and R. Kamalapurkar, "Model-based inverse reinforcement learning for deterministic systems," *Automatica*, 2022. DOI: **10.1016/j.automatica.2022.110242.** **2022**
- **S. M. N. Mahmud**, S. Nivison, Z. I. Bell and R. Kamalapurkar, "Safe Model-Based Reinforcement Learning for Systems with Parametric Uncertainties," *Frontiers in Robotics and AI*, 2021. DOI: **10.3389/frobt.2021.733104.** **2021**

Accepted Conference Papers

- **S. M. N. Mahmud**, K. Hareland, S. Nivison, Z. I. Bell and R. Kamalapurkar, "A Safety Aware Model Based Reinforcement Learning Framework for Systems with Uncertainties," *Proc. Am. Control Conf.*, New Orleans, USA, 2021 pp. 1979-1984. DOI: **10.23919/ACC50511.2021.9482976.** **2021**
- R. V. Self, **S. M. N. Mahmud**, K. Hareland and R. Kamalapurkar, "Online Inverse Reinforcement Learning with Limited Data," *IEEE Conf. Decis. Control*, Jeju Island, Korea (South), 2020, pp. 603-608. **2020** DOI: **10.1109/CDC42340.2020.9303883.**

Journal Papers under Review

- **S. M. N. Mahmud**, M. Abudia, S. Nivison, Z. I. Bell and R. Kamalapurkar, "Safe Controller for Output Feedback Linear Systems using Model-Based Reinforcement Learning". Pre-print version: **https://arxiv.org/abs/2204.01409.** **2022**
- **S. M. N. Mahmud**, M. Abudia, S. Nivison, Z. I. Bell and R. Kamalapurkar, "Safety Aware Model-Based Reinforcement Learning for Optimal Control of a Class of Output-Feedback Nonlinear Systems". Pre-print version: **https://arxiv.org/abs/2110.00271.** **2021**
- R. V. Self, M. Abudia, **S. M. N. Mahmud** and R. Kamalapurkar, "Online Simultaneous State and Parameter Estimation". Pre-print version: **https://arxiv.org/abs/1703.07068.** **2020**

Poster Abstracts (Peer Reviewed)

- **S. M. N. Mahmud** and R. Kamalapurkar, "A Safety Aware Reinforcement Learning Approach for Dynamic Models with Uncertainties," *3rd annual MAE Graduate Research Symposium.* **Feb 2020**
- **S. M. N. Mahmud**, M. Harlen and R. Kamalapurkar, "A Hierarchical, Scale Separation Based Approached to Wind Aware Guidance and Control," *MAE Grad Student Recruiting Event 2020.* **Dec 2019**

Achievements and Awards

Ross Fellowship, Purdue University.	**Aug. 2022**
Engineering College Scholarship, Purdue University.	**Aug. 2022**
Student Registration Grant, American Control Conference 2021	**May 2021**
Bangladesh - Sweden Trust Fund Travel grant.	**Feb. 2021**
Runnrers up, Inter school math Olympiad, Dhaka, Bangladesh	**June 2008**
Champions, Inter school physics Olympiad, Dhaka, Bangladesh	**Feb. 2008**

Reviewer

- *Automatica* **2021-Current**
- *IEEE Control Letters* **2021-Current**
- *IEEE Transactions on Aerospace and Electronic Systems* **2021-Current**
- *Optimal Control Applications and Methods* **2021-Current**

Volunteer Activities

President, Bangaldesh Student Association, OSU.	**Jan. 2021 - Jan. 2022**
Public Relations Officer, Muslim Student Association, OSU.	**May 2020 - May 2021**
Student Representative, ASME OSU Chapter.	**Jan. 2020 - Dec. 2020**
Editor-in-Chief, CORE 2.0, Mecceleration.	**Jan. 2015 - Dec. 2015**
Head of publications, Mecceleration.	**Jan. 2015 - Dec. 2015**
Sub coordinator, Robotics, Mecceleration.	**Jan. 2014 - Dec. 2015**