MD FERDOUS ALAM

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Department of Mechanical and Aerospace Engineering ◇ The Ohio State University

EDUCATION

Ph.D. in Mechanical Engineering *8/2018 - Present*
The Ohio State University, Columbus, OH Advisor: David J. Hoelzle
Focus: Machine learning, Autonomous systems

M.S. in Mechanical Engineering *8/2018 - 12/2021*
The Ohio State University, Columbus, OH Advisor: David J. Hoelzle
Focus: Machine learning, Autonomous systems

B.Sc. in Mechanical Engineering *5/2010 - 9/2015*
Bangladesh University of Engineering and Technology, Dhaka, Bangladesh

RESEARCH INTERESTS

My core research interests span artificial intelligence (AI), machine learning (ML), deep learning and control theory for decision making in autonomous systems. My research vision is to build high-impact real-world autonomous systems such as manufacturing systems with intelligent process control for increased productivity, robots that can perform complex tasks with no/minimal human supervision for application in environments that are not feasible/unsafe for humans. To achieve this vision, I am focusing on developing data-efficient learning algorithms with knowledge transfer between tasks, representation learning and AI/ML systems integration for automation in manufacturing and robotics.

My Ph.D. research focuses on developing data efficient machine learning algorithms, with specific interest in sequential decision making under uncertainty or reinforcement learning, for building next generation of manufacturing systems that can design and manufacture complex geometry artifacts without any human intervention. I, along with my team, has also built a state-of-the-art autonomous manufacturing research robot to test these algorithms on a physical system in real-time. Later, I have developed scalable reinforcement learning algorithm for high dimensional complex robotics applications. Additionally, I have developed AI assisted generative model for sequential volumetric design tasks.

SELECTED PUBLICATIONS

[1] **Md Ferdous Alam**, Max Shtein, Kira Barton & David J. Hoelzle, "Beyond inverse design: A robust scalable framework for autonomous manufacturing systems", (in prep)

[2] **Md Ferdous Alam**, Yi Wang, Chin-Yi Cheng, Linh Tran & Rodger Luo, "Latent Representation for Sequential Volumetric Design", to be submitted to *International Conference on Machine Learning (ICML)*, 2023

[3] **Md Ferdous Alam**, Parinaz Naghizadeh & David J. Hoelzle, "A unified approach for transfer in reinforcement learning between fixed domain environments", to be submitted to *International Conference on Machine Learning (ICML)*, 2023 and extended version is to be submitted at *Journal of Machine Learning Research (JMLR)*

[4] **Md Ferdous Alam**, Sarp Sezer, Zhi Zhang, Max Shtein, Kira Barton & David J. Hoelzle, "Reinforcement learning for autonomous manufacturing systems", to be submitted to *Nature Machine Intelligence*

[5] Zhi Zhang, Antony George, Chaitanya Krishna Prasad Vallabh, **Md Ferdous Alam**, Chris Eubel, Max Shtein, Kira Barton, David Hoelzle, "Autonomous manufacturing testbed to evaluate machine learning algorithm performance", under review in ASME Journal of Manufacturing Science and Engineering (JMSE)

[6] **Md Ferdous Alam**, Max Shtein, Kira Barton & David J. Hoelzle, "Reinforcement learning enabled autonomous manufacturing using transfer learning and probabilistic reward modeling", in IEEE Control Systems Letters (L-CSS), and also accepted at Conference on Decision and Control (CDC), 2022, (paper)

[7] **Md Ferdous Alam**, Max Shtein, Kira Barton & David J. Hoelzle, "Sample efficient transfer in reinforcement learning for high variable cost environments with an inaccurate source reward model", in American Control Conference (ACC), 2022 **[Invited paper]**, (paper), (code)

[8] **Md Ferdous Alam**, Max Shtein, Kira Barton & David J. Hoelzle, "A physics guided reinforcement learning framework for an autonomous manufacturing system", American Control Conference (ACC), 2021, (paper), (code)

[9] **Md Ferdous Alam**, Max Shtein, Kira Barton & David J. Hoelzle, "Autonomous Manufacturing Using Machine Learning: A Computational Case Study With a Limited Manufacturing Budget", in Manufacturing Science and Engineering Conference (MSEC), 2020 **[Best paper award]**, (paper)

PROFESSIONAL EXPERIENCE

Hoelzle Research Lab *08/2018 - Present*
Ph.D. Candidate in MAE

- Developed reinforcement learning algorithms for autonomous design and manufacturing systems, deployed proposed learning algorithms and traditional Bayesian optimization algorithm on a prototypical manufacturing research robot for real-time decision making, developed theoretical and empirical foundations of transfer in RL for high dimensional robot learning tasks

AI Lab, Autodesk Inc. *08/2022 - 12/2022*
Residency program (Mentor: Rodger Luo)

- Self-supervised approach for learning representation of volumetric design
(*to be submitted to CVPR 2023*)

AI Lab, Autodesk Inc. *05/2022 - 08/2022*
Research Intern (Mentor: Rodger Luo)

- Built code base for creating 3D design dataset, training Transformer based deep neural network model, and visualization of voxel design

TEACHING EXPERIENCE

Graduate Teaching Associate *08/2022 - present*
The Ohio State University

- MEE 3751: Kinematics and Mechanism Design — Fall 2022
Role: Recitation, grading, proctoring exams
- MEE 3760: Design and Analysis of Machine Elements — Fall 2022
Role: Recitation

Lecturer *03/2016 - 08/2018*
Shahjalal University of Science and Technology, Bangladesh

- MEE 128: Programming methodology for mechanical engineering — Spring 2018
  Role: course developer, instructor
- MEE 124: Mechanical engineering drawing — Spring 2017, Spring 2018
  Role: course developer, instructor
- MEE 121: Introduction to Mechanical Engineering — Fall 2016, Fall 2017
  Role: course developer, instructor

Guest Lecturer
Hajee Mohammad Danesh Science and Technology University, Bangladesh

- Course: Measurement and Instrumentation — Spring 2018
  Role: Partial course developer, instructor

AWARDS AND RECOGNITIONS

- I was awarded the student travel grant for Conference on Decision and Control (CDC), 2022
- I was awarded the student travel grant for American Control Conference (ACC), 2022
- I achieved 3rd place in the 3-minute thesis competition at MAE department, OSU, 2021
- I was awarded the student travel grant for American Control Conference (ACC), 2021
- I was featured in the MAE department news board, 2021
- I received the **Best paper award** in Manufacturing Science and Engineering Conference (MSEC), 2020
- I received the Dean's List Scholarship for undergraduate academic excellence at Bangladesh University of Engineering and Technology, 2010

ACADEMIC & PROFESSIONAL SERVICES

Presentations and invited talks

- Incorporating Physics Based Knowledge in Manufacturing Decision Making via Transfer Reinforcement Learning"
  → INFORMS annual meeting, 2022
- "Machine learning driven autonomous design and manufacturing"
  → Intel pathfinding team, 2022
- 3-minute thesis competition, MAE department, OSU, 2021
- State-of-the art in learning algorithms
  → ME Department, SUST, 2019

Journal Reviewer

- IEEE Transaction on automatic control (TAC), Mechatronics (Elsevier)

Conference Reviewer

- Conference on decision and control (CDC), American Control Conference (ACC), IEEE Conference on Control Technology and Applications (CCTA), North American Manufacturing Research Conference (NAMRC), Manufacturing Science and Engineering Conference (MSEC)

Affiliation

- Institute of Electrical and Electronics Engineers (IEEE), American Society of Mechanical Engineers (ASME), INFORMS

Mechanical Engineering Graduate student Association *08/2021 - 05/2022*
Vice President

- Helped organizing professional seminars and activities for graduate students

ADVISING AND MENTORSHIP

Student	Mentoring institution	Current affiliation
Sarp Sezer	MAE senior, OSU	M.S. student, KU Leuven
Chris Eubel	MAE senior, OSU	Robotics engineer, Path robotics
Christina Duong	CSE sophomore, OSU	CSE junior, OSU
Shamudra Dey	ME senior, SUST	PhD student, Medical College of Wisconsin
A K M Ashikuzzaman	ME senior, SUST	Lecturer at SUST, Bangladesh

CODES

Autonomous manufacturing *08/2018 - Present*
Language: Python, MATLAB, Tools used: scikit-learn, Pytorch, LABVIEW, git

- Implementation of sequential decision making algorithms in a custom manufacturing research bot

Deconstructed ML *08/2018 - Present*
Language: Python, Tools used: scikit-learn, Pytorch, OpenAI Gym, Robosuite

- Modular implementation of statistical machine learning algorithms and state-of-the-art deep leanring algorithms for tutorial purposes i.e. MLP, CNN, LSTM, GAN, Transformer
- Modular implementation of state-of-the-art reinforcement learning algorithms i.e. DQN, PPO, DDPG, SAC

Self-supervised learning for sequential 3D designs *05/2022 - Present*
PyTorch, python, AWS, Flask, git

- Developed code base for highly modular transformer models from scratch using PyTorch
- Developed and implemented transformer based auto-encoder for extracting latent dimension of sequential 3D designs
- Developed pipeline for creating novel dataset of sequential 3D designs
- Developed modular code for training transformer in AWS and worked on visualization of 3D designs in browser based server application

ACADEMIC TRAINING

Future Academic Scholars Training I for MAE Fall 2022
The Ohio State University

- Taught undergraduate controls course as part of the future faculty training process
- Focused on pedagogy and engineering education in the USA undergraduate classroom

Future Academic Scholars Training II for MAE Spring 2023
The Ohio State University

- training for successful academic position in a research university
- training on how to write successful research grant proposals

REFERENCES

- **David Hoelzle**
  Associate Professor of Mechanical and Aerospace Engineering
  The Ohio State University
  phone: (614) 256 7388
  email: hoelzle.1@osu.edu

- **Kira Barton**
  Associate Professor of Mechanical Engineering
  Associate Professor of Robotics
  Miller Faculty Scholar
  University of Michigan
  phone: (734) 764-7293
  email: bartonkl@umich.edu

- **Parinaz Naghizadeh**
  Assistant Professor of Integrated Systems Engineering
  Assistant Professor of Electrical and Computer Engineering
  The Ohio State University
  phone: (614) 247-1638
  email: naghizadeh.1@osu.edu