

MUHAMMAD WASEEM

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PROFILE

- ◆ PhD student with a research interest in **Automation and Control of Complex Systems**.
- ◆ Research interest in **Generative AI** for production planning and control.
- ◆ Experience in **Modeling and Control of Smart Manufacturing Systems**.
- ◆ Experience in **Machine Learning** and **Deep Reinforcement Learning**

EDUCATION

- ◆ **PhD. in Mechanical and Aerospace Engineering** (CGPA: 3.92/4.00) Jan-2022 -- Present
University of Virginia, Charlottesville, USA
Advisor: Dr. Qing (Cindy) Chang
- ◆ **M.S. in Industrial Engineering** (CGPA: 4.00/4.00) 2017- 2019
Specialization: Manufacturing Systems Engineering
University of Engineering & Technology Peshawar, Pakistan
- ◆ **BS in Industrial Engineering** (CGPA: 3.90/4.00) 2013- 2017
University of Engineering & Technology Peshawar, Pakistan

SKILLS

- ◆ **Technical Skills:** Supervised Learning, Reinforcement Learning, Data Analytics, Graph Neural Networks (GNN), Natural Language Processing (NLP), State-Space modeling, MDP modeling, Optimal control
- ◆ **Programming Languages:** MATLAB, Python (PyTorch, TensorFlow), R, Arduino
- ◆ **Computer Skills:** Windows, MacOS, Linux, Git version control, HTML, CSS
- ◆ **CAD, Modelling and Analysis:** SolidWorks, PTC Creo, Ansys, PTC Simulate, PSE Toolbox, Siemens Technomatix, Simul8, Abaqus
- ◆ **Languages:** English (Fluent), Pashto (Native), Urdu (Fluent), Hindi (Fluent)
- ◆ **Others:** Project Management, Leadership, Critical Thinking, Academic writing

RELEVANT EXPERIENCES

Graduate Research Assistant Jan-2022 – Present
Intelligent Systems Lab, University of Virginia

- ◆ Developed a novel math model for dynamic robot assisted multiproduct flexible manufacturing system (FMS), derived system properties, and introduced key performance indicators. Established a reinforcement learning (RL) based control method.
- ◆ Developed a novel NASH-MADDPG algorithm by integrating deep reinforcement learning (DRL) and Game theory (NASH Game) for effective control of complex manufacturing systems under uncertainty.
- ◆ Developed a GNN based control strategy to achieve 25% - 30% energy efficiency in a state-of-the-art wood drying system.
- ◆ Developed a control strategy for multiproduct FMS with stochastic market demand and random machine disruptions.
- ◆ Modelled an integrated microgrid-manufacturing system, incorporating battery degradation costs, and developed a control strategy for optimization of production throughput, energy consumption and battery degradation.

- ◆ Leveraged pretrained large language models (LLMs) for advanced manufacturing control, investigating their effectiveness in bottleneck detection and process optimization.
- ◆ Modelled an industrial dryer and developed a control strategy for energy efficiency and quality enhancement.
- ◆ Implemented multiple Reinforcement Learning algorithms including Actor-2-Critic (Synchronous and Asynchronous), Deep-Q Learning, and SARSA to address real-time challenges such as robot assignment, and product selection in a multiproduct FMS. Design and execute experiments to validate research hypotheses and proposed solutions.
- ◆ Collaborate with interdisciplinary teams, including faculty, researchers, and industry partners, on the DOE project for wood drying control.
- ◆ Authored and published multiple articles in international journals and conferences and participated in peer reviewing several journal articles for publication in international journals.

Research Intern

May-2025 -- Aug-2025

Materials and Manufacturing Systems Research Lab, General Motors

- ◆ Model the general automotive assembly line using Siemens Tecnomatix Plant Simulation.
- ◆ Develop a temporal graph neural network (GAT-LSTM) model to estimate throughput along the assembly line.
- ◆ Build a state prediction model to forecast workstation and buffer states in the general assembly process.
- ◆ Design a control strategy for conveyor systems to optimize performance and minimize line stoppages.
- ◆ Create a digital twin surrogate model for performance analysis, bypassing the longer simulation run times.

Research Intern

May-2024 -- Aug-2024

Materials and Manufacturing Systems Research Lab, General Motors

- ◆ Developed a Digital Twin Surrogate for the RESS plant, optimizing manufacturing processes using traditional ML models and deep learning models.
- ◆ Analyzed and processed real-time data from Power BI, applying data cleaning, feature engineering, and scaling to prepare datasets for model training.
- ◆ Fine-tuned and optimized ML/DL models to predict machine performance, and throughput fluctuations, improving system efficiency.
- ◆ Created Power BI dashboards to visualize model predictions and key performance metrics, providing actionable insights for plant operations.
- ◆ Conducted model evaluation and performance analysis using cross-validation and hyperparameter tuning, improving prediction accuracy and robustness.
- ◆ Collaborated with engineering teams to deploy machine learning models into real-time plant systems, enabling continuous optimization and data-driven decision-making.

Lab Engineer

Mar-2019 -- Dec-2021

Manufacturing Systems and Operations Research Lab, UET Peshawar Pakistan

- ◆ Developed and led hands-on labs in Manufacturing Systems Engineering and Operations Research
- ◆ Mentored senior students on projects related to production systems modeling and control, providing guidance on problem-solving, system design, and analysis.
- ◆ Facilitated a collaborative learning environment by helping students gain hands-on experience with engineering tools and software to address complex engineering challenges.
- ◆ Supported senior faculty in cutting-edge research projects such as the design and fabrication of prosthetic limbs, contributing to interdisciplinary innovations and advancements.

Shift Engineer

Sep-2017 -- Aug-2018

- ◆ Supervised and managed a molding compound powder manufacturing plant with a team of 15 members.
- ◆ Conducted time and motion study and optimized material handling operations, achieving an 11% boost in productivity.
- ◆ Effectively supervised, managed, and trained 5 new employees.
- ◆ Enhanced production output by 7% via optimization of batch processing times.
- ◆ Actively participated in Research & Development, emphasizing commitment to collaborative research efforts.

AWARDS and MEMBERSHIPS

- ◆ Distinguished Research Award (Link Lab UVA 2025)
- ◆ MAE Outstanding Graduate Research Award (UVA 2025)
- ◆ NSF Travel Grant Award (2025)
- ◆ GradeStar fellowship (2024)
- ◆ Distinction Award (2019)
- ◆ Gold Medal Award (2017)
- ◆ Academic Excellence Scholarship (UET Peshawar (2013-2017))
- ◆ IISE Student Member (Aug 2017 - July 2021)
- ◆ Pakistan Student Association, University of Virginia (Aug 2022 - Present)

PUBLICATIONS

Peer-Reviewed Journal Articles

1. Machine Learning-Enhanced Digital Twins for Predictive Analytics in Battery Pack Assembly. **Muhammad Waseem**, Changbai Tan, Seog-Chan Oh, Jorge Arinez, Qing Chang (2025). Journal of Manufacturing Systems.
2. Integrated energy optimization in manufacturing through multiagent deep reinforcement learning: Holistic control of manufacturing, microgrid systems, and battery storage, **Muhammad Waseem**, Mihitha Sarinda Maithripala, Qing Chang, Zongli Lin. (2025) ASME Journal of Manufacturing Science and Engineering.
3. Demand-Driven Hierarchical Integrated Planning-Scheduling Control for a Mobile Robot-Operated Flexible Smart Manufacturing System. Chen Li, Kshitij Bhatta, **Muhammad Waseem**, Qing Chang. (2025) Journal of Robotics and Computer Integrated Manufacturing.
4. From Nash Q-Learning to Nash-MADDPG: Advancements in Multiagent Control for Multiproduct Flexible Manufacturing Systems, **Muhammad Waseem**, Qing Chang. (2024), Journal of Manufacturing Systems.
5. Energy-efficient and quality conscious control of conveyor belt dryers in petrochemical production. **Muhammad Waseem**, Kshitij Bhatta, Chen Li, Nabeel Haider, Qing Chang (2024). Nature portfolio journal (npj) Advanced Manufacturing.
6. Dynamic modeling and analysis of multi-product flexible production line, **Muhammad Waseem**, Qing Chang, Chen Li (2023). International journal of computer integrated manufacturing.
7. Adaptive Mobile Robot Scheduling in Multiproduct Flexible Manufacturing Systems Using Reinforcement Learning, **Muhammad Waseem**, Qing Chang (2023). ASME Journal of manufacturing science and engineering.

8. Optimization of tensile and compressive behaviour of PLA 3D printed parts using categorical response surface methodology, **Muhammad Waseem**, T Habib, U Ghani, M Abas, QMU Jan, MAZ Khan (2022). International Journal of Industrial and Systems Engineering.
9. Manufacturing productivity analysis by applying overall equipment effectiveness metric in a pharmaceutical industry, Muhammad Zubair, Shahid Maqsood, Tufail Habib, Qazi Muhammad Usman Jan, Uroosa Nadir, **Muhammad Waseem**, QM Yaseen (2022). Cogent Engineering.
10. Productivity enhancement at molding compound manufacturing plant by applying time and motion analysis, **Muhammad Waseem**, U Ghani, T Habib, S Noor, T Khan (2021). Mehran University Research Journal of Engineering & Technology.
11. Productivity enhancement with material handling system design and human factors analysis-a case study, **Muhammad Waseem**, U Ghani, T Habib, S Noor (2021). Mehran University Research Journal of Engineering & Technology.
12. Multi-response optimization of tensile creep behavior of PLA 3D printed parts using categorical response surface methodology, **Muhammad Waseem**, B Salah, T Habib, W Saleem, M Abas, R Khan, U Ghani (2020). MDPI Polymers.
13. Excess noise reduction with ear protector applying mathematical algorithm: A case of medium density fiber industry, S Khan, I Noor, T Habib, **Muhammad Waseem** (2020). Sage Noise & Vibration Worldwide.

Journal Articles Submitted / Under Review

14. Integrating Market-driven Demand Adaptation in Multi-Agent Deep Reinforcement Learning for Controlling Multiproduct Flexible Manufacturing Systems, **Muhammad Waseem**, Qing Chang. (Under Review in the Journal of Intelligent Manufacturing).
15. Pretrained LLMs as Real-Time Controllers for Robot Operated Serial Production Line. **Muhammad Waseem**, Kshitij Bhatta, Chen Li, Qing Chang. (Under Review in Expert Systems with Applications Journal).

Conference Papers and Presentations

16. Dynamic modelling and real-time performance analysis of multiproduct batch manufacturing systems with perishable products. Kshitij Bhatta, **Muhammad Waseem**, Chen Li, Qing Chang (2024). (Presented at the 52nd North American Manufacturing Research Conference (NAMRC 52), published in the proceedings).
17. Can Pre-trained LLMs be used as out-of-the-box bottleneck detectors? An explorative study. Chen Li, Kshitij Bhatta, **Muhammad Waseem**, Jorge Arinez, Qing Chang (2025). (Accepted in 53rd North American Manufacturing Research Conference (NAMRC 53)).
18. LLM-Guided Exploration for Efficient Control in Robot-Operated Flexible Manufacturing Systems. **Muhammad Waseem**, Kshitij Bhatta, Chen Li, Qing Chang (2025). (Under review in IEEE Conference on Automation and Systems Engineering (IEEE-CASE)).