Huzaifa Mustafa Unjhawala

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Education

University of Wisconsin-Madison May 2026
Ph.D. Mechanical Engineering, Minor in Mathematics *Current GPA: 3.92/4.0*

University of Wisconsin-Madison Dec 2024
MS Computer Science (Course-based) *Current GPA: 3.9/4.0*

University of Wisconsin-Madison May 2023
MS Mechanical Engineering *Current GPA: 3.94/4.0*

National Institute Of Technology - Trichy June 2020
B.Tech with Honors in Mechanical Engineering *GPA: 8.9/10.0*

Coursework

Courses: High Performance Computing, Scientific Computing, Non-Linear Finite Elements, Mechanics of Continua, Machine Learning, Stochastic Computational Methods, Non-linear Optimization, Kinematics and Dynamics of Machine Systems
Awards: Baden-Württemberg Stipendium

Skills

Languages: C/C++, CUDA, Python (incl. JAX, PyTorch), Matlab, LaTeX
Tools: Git, Linux (Arch, Ubuntu), docker, CMake, Shell (Bash, Zsh), SWIG

Research Experience

Low-Fidelity Vehicle Dynamic Models | *S*imulation Based Engineering Lab, UW Madison Jan 2022 – May 2023

- Developed a library of Low-Fidelity Vehicle Models that are 1000x faster than real-time on a CPU
- Parallelized the code using CUDA, achieving simulation of 300,000 vehicles in real-time
- Used a SWIG wrapper to provide a Python API to the model
- Used Bayesian Optimization to tune the parameters of the model to match real-world data and data from high-fidelity vehicle models
- Open source code can be found here

Fast Terramechanics Simulation | *Simulation Based Engineering Lab, UW Madison* Feb 2024 – Present

- Exploring the use of Graph-Neural Network and Transformer based models for fast terramechanics simulations with the main goal to enable real-time simulation of large-scale terrains for designing the autonomy stacks of construction equipment
- Early results can be found here

GymChrono | *Simulation Based Engineering Lab, UW Madison* May 2023 – Present

- Co-maintaining the open-source Gymnasium environment for Project Chrono, a physics-based simulation engine for use in Reinforcement Learning applications
- Co-hosted a training session at MaGIC whose slides can be found here
- Open source code can be found here

Sensor Simulation Validation | *Simulation Based Engineering Lab, UW Madison* Dec 2023 – Mar 2024

- Validating GPS and IMU sensor's in simulators such as AirSim and Project Chrono for velocity estimation using a novel contextual performance difference based approach

Calibration of Terramechanics Models Jan 2023 – May 2023

- Contributed to the Bayesian Calibration of the Soil Contact Model (SCM) with the use of data generated with a virtual bevameter test for high-fidelity terramechanics simulations

Undergraduate Experience in Simulation May 2018 – May 2020

- Awarded the Baden-Württemberg Stipendium for a 3-month research internship at the Karlsruhe Institute of Technology, Germany, where I worked on multi-body simulation models for axial thrust bearings in MSC Adams
- Built a transient fluid flow simulation model that was used to optimize the pressure drop of a Magneto-Rheological Damper in ANSYS CFX and AIM
- As part of the SAE Baja team, I was responsible for the design and simulation of the wheel assembly, achieving 20% weight reduction while maintaining the same strength

Relevant Work Experience

National Renewable Energy Laboratory | *Graduate Engineering Intern* Jul. 2023 – Sep. 2023

- Contributed to HydroChrono - a C++ library for enabling Wave Energy Converter (WEC) simulations with Project Chrono
- Refactored code and setup testing infrastructure for the library
- Explored the use of multi-fidelity models for WEC simulations by enabling seamless transition from potential flow solvers used in HydroChrono to high-fidelity SPH solvers used in Project Chrono
- Open source code can be found here

Publications

Journal Publications

- Hu, W., Li, P., **Unjhawala, H.M.**, Serban, R. & Negrut, D. (2023) **Calibration of an expeditious terramechanics model using a higher-fidelity model, Bayesian inference, and a virtual bevameter test.** Journal of Field Robotics, 1–20. https://doi.org/10.1002/rob.22276
- **Unjhawala, H. M.**, Zhang, R., Hu, W., Wu, J., Serban, R., and Negrut, D. (April 8, 2023). **Using a Bayesian-Inference Approach to Calibrating Models for Simulation in Robotics.** ASME. J. Comput. Nonlinear Dynam. June 2023; 18(6): 061004. https://doi.org/10.1115/1.4062199
- **H. Unjhawala** et al., **An Expeditious and Expressive Vehicle Dynamics Model for Applications in Controls and Reinforcement Learning**, in IEEE Access, vol. 12, pp. 33000-33015, 2024, doi: 10.1109/ACCESS.2024.3368874.https://ieeexplore.ieee.org/document/10443432

Conference Publications

- Zhou, Z., **Unjhawala, H.**, Kamaraj, A., Kissel, A., Lee, J., Serban, R., Negrut, D., "A Chrono-Based Framework for Large-Scale Traffic Simulation with Human-In-The-Loop." Proceedings of the Multibody 2023 11th ECCOMAS Thematic Conference on Multibody Dynamics, Lisboa, Portugal. July 24-28, 2023. Preprint https://doi.org/10.13140/RG.2.2.23133.59361

Under Review

- **Unjhawala, H.**, Mahajan, I., Serban, R., Negrut, D., **Fast and Accurate Low Fidelity Dynamic Models for Robotics**, Journal of Open Source Software, Preprint https://github.com/uwsbel/low-fidelity-dynamic-models/blob/12-complete-paper-for-joss/paper/paper.md
- Ishaan Mahajan, **Huzaifa Unjhawala**, Harry Zhang, Zhenhao Zhou, Aaron Young, Alexis Ruiz, Stefan Caldararu, Nevinu Batagoda, Sriram Ashokkumar, and Dan Negrut. **Quantifying the Sim2Real Gap for GPS and IMU Sensors.**, Under Review IROS 2024
- Zhang, H., Caldararu, Young, A., Ruiz, A., **Unjhawala, H.**, Mahajan, I., S., Ashokkumar, S., Bakke, L., Negrut, D., **A Study on the Use of Simulation in Synthesizing Path-Following Control Policies for Autonomous Ground Robots**, Under Review IROS 2024