

# Huzaifa Mustafa Unjhawala

<https://github.com/Huzaifg>
[linkedin.com/in/unjhawala/](https://www.linkedin.com/in/unjhawala/)
[unjhawala@wisc.edu](mailto:unjhawala@wisc.edu)

## EDUCATION

<b>University of Wisconsin-Madison</b> <i>Ph.D. Mechanical Engineering, Minor in Mathematics</i>	May 2026 Current GPA: 3.92/4.0
<b>University of Wisconsin-Madison</b> <i>MS Computer Science (Course-based)</i>	Dec 2024 Current GPA: 3.9/4.0
<b>University of Wisconsin-Madison</b> <i>MS Mechanical Engineering</i>	May 2023 Current GPA: 3.94/4.0
<b>National Institute Of Technology - Trichy</b> <i>B.Tech with Honors in Mechanical Engineering</i>	June 2020 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, L<sup>A</sup>T<sub>E</sub>X  
**Tools:** Git, Linux (Arch, Ubuntu), docker, CMake, Shell (Bash, Zsh), SWIG

## RESEARCH EXPERIENCE

<b>Low-Fidelity Vehicle Dynamic Models</b>   <i>Simulation Based Engineering Lab, UW Madison</i>	Jan 2022 – May 2023
<ul style="list-style-type: none"> <li>Developed a library of Low-Fidelity Vehicle Models that are 1000x faster than real-time on a CPU</li> <li>Parallelized the code using CUDA, achieving simulation of 300,000 vehicles in real-time</li> <li>Used a SWIG wrapper to provide a Python API to the model</li> <li>Used Bayesian Optimization to tune the parameters of the model to match real-world data and data from high-fidelity vehicle models</li> <li>Open source code can be found <a href="#">here</a></li> </ul>	
<b>Fast Terramechanics Simulation</b>   <i>Simulation Based Engineering Lab, UW Madison</i>	Feb 2024 – Present
<ul style="list-style-type: none"> <li>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</li> <li>Early results can be found <a href="#">here</a></li> </ul>	
<b>GymChrono</b>   <i>Simulation Based Engineering Lab, UW Madison</i>	May 2023 – Present
<ul style="list-style-type: none"> <li>Co-maintaining the open-source Gymnasium environment for Project Chrono, a physics-based simulation engine for use in Reinforcement Learning applications</li> <li>Co-hosted a training session at <a href="#">MaGIC</a> whose slides can be found <a href="#">here</a></li> <li>Open source code can be found <a href="#">here</a></li> </ul>	
<b>Sensor Simulation Validation</b>   <i>Simulation Based Engineering Lab, UW Madison</i>	Dec 2023 – Mar 2024
<ul style="list-style-type: none"> <li>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</li> </ul>	
<b>Calibration of Terramechanics Models</b>	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

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### 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

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### Journal Publications

- Hu, W., Li, P., **Unjhwala, 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>
- **Unjhwala, 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. Unjhwala 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., **Unjhwala, 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

- **Unjhwala, 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 Unjhwala,** 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., **Unjhwala, 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

## LEADERSHIP

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### SAE Baja | Captain

2019-2020

- Responsible for overall design ideation, manufacturing plan, vehicle integration and management of 30 team members
- Finished **5/150** in *SAE Baja India 2020* and led the team to multiple podium finishes at *Enduro Student India 2020*