

# Jason Zhenhao Zhou

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## Personal Profile

I'm a simulation engineer double-major in Mechanical Engineering and Computer Science at the University of Wisconsin Madison. My research focuses on the development and validation of digital twins and their applications in control designs of robotic systems, autonomous vehicles, and smart infrastructures. My research experiences allow me to develop strong programming capabilities, knowledge in high-performance computing, deep understandings in multi-body dynamics and physics simulation, and computer graphics. I am currently an active member of Simulation-Based Engineering Lab (SBEL) at the University of Wisconsin-Madison and an active developer of open-source multi-physics simulation engine Project Chrono.

## Education

### University of Wisconsin-Madison

Madison, WI

Doctor of Philosophy in Mechanical Engineering

May 2025

- GPA: 3.9.
- Expected Graduation on May 12, 2025.
- **Research Focus:** Reinforcement Learning in Robotics and Sim2Real Transfer.

### University of Wisconsin-Madison

Madison, WI

Master of Science in Mechanical Engineering

May 2023

- GPA: 3.9.
- **Courses:** Feedback Control of Autonomous Systems, Advanced Robotics, Computational Fluid Dynamics, Computational Dynamics, Mechanical Design Optimization, Thermodynamics, Heat Transfer.
- **Research Thesis:** An Open-Source Chrono-Based Framework for Large-Scale Traffic Simulation with Human In The Loop

### University of Wisconsin-Madison

Madison, WI

Master of Science in Computer Science

Dec 2022

- GPA: 3.9.
- **Courses:** Data Science, Machine Learning, Wireless Communication, Computer Networks, Distributed Computing, Computer Architectures.

### University of Wisconsin-Madison

Madison, WI

Bachelor of Science in Mechanical Engineering

Dec 2020

- GPA: 3.8.
- **Courses:** Robotic Systems, Manufacturing Automation, Design Optimization, Thermal Dynamics, Fluid Dynamics, Static and Dynamic Systems

### University of Wisconsin-Madison

Madison, WI

Bachelor of Science in Computer Science

Dec 2020

- GPA: 3.8.
- **Courses:** Machine Learning, Computer Vision, Computer Graphics, Operating System, Optimization Theory, Database

## Work Experience

### Simulation-Based Engineering Lab at UW-Madison

Madison, WI

Graduate Research Assistant

Jan 2021 - Present

- Advisor: Professor Dan Negrut.
- Developed autonomous vehicle coordination and simulation, leveraged simulation fidelity and real-time performance for Human-In-The-Loop, Hardware-In-The-Loop and Software-In-The-Loop applications. Head developer of chrono::HIL, a plug-in of Project Chrono (<https://projectchrono.org/>) to provide human-in-the-loop and real-time simulation support for traffic scenarios and vehicle dynamics. chrono::HIL provides flexible simulator hardware coupling capabilities, distributed simulation support, soft real-time simulation support, and multiple vehicle dynamic models.
- Integrated sensor (lidar/radar/camera sensor) simulation using chrono::sensor into traffic scenarios to assist the development of autonomous vehicle control and sensor fusion. Provided simulation support for human-factor research conducted by Cognitive Systems Laboratory at UW-Madison. Funded by National Science Foundation OAC2209791.
- Involved in the development of Gym-Chrono, a Deep Reinforcement Learning environment and pipeline using Project Chrono to enable research on the transfer of learned policy from simulation to reality.
- Extraterrestrial rover and robot mechanical component simulation. Applications/development/validation of SCM (Semi-Emperical Soil Contact Model), SPH (Smoothed Particle Hydrodynamics), and DEM (Discrete Element Method) deformable terrain. Developed the VIPER lunar rover model and the Curiosity mars rover model in the chrono::robot module. Integrated sensor simulation support to provide Lidar/Radar perception data in harsh lunar environment. Funded by NASA to support 2023 VIPER lunar mission.

## UW-Madison

Graduate Teaching Assistant

Madison, WI

Jun 2022 - Present

- **ME/ECE/COMP SCI 759:** High Performance Computing - Parallel Computing Programming, CUDA, OpenMP, MPI; Parallel Program Optimization, GPU and Accelerator Architectures.
- **ME 451:** Multibody Dynamics - Kinematics and Dynamics; Forward and Inverse Dynamics; Formulation of Multibody Systems.

## Simulation-Based Engineering Lab at UW-Madison

Undergraduate Research Assistant

Madison, WI

Jun 2020 - Dec 2020

- Advisor: Professor Dan Negrut.
- Developed and validated chrono::granular (later renamed as chrono::gpu), a CUDA solver for granular dynamics. chrono::granular can be used to simulate homogeneous granular material; applications include granular material properties testing and deformable terrain for off-road vehicle research.
- Developed parallel computing and synchronization function, named as chrono::synchrono support for Project Chrono. - MPI and DDS interfaces of chrono::vehicles and chrono::robot; utilized of parallel computing for real-time performance.

## Human Computer Interaction Lab at UW-Madison

Undergraduate Research Assistant

Madison, WI

Sep 2019 - May 2020

- Advisor: Professor Bilge Mutlu.
- Developed a QR Marker object tracking program based on OpenCV in C++. The program helps educational robots to identify objects and their movements in order to facilitate human-computer interaction.
- Designed and developed of simulation environment for robot localization algorithm using ROS2. The simulation environment allows a Turtlebot model to follow certain trajectories in an indoor environment relying purely on QR codes identified by the machine learning algorithm.
- Created of the CAD models for robot's parts using Solidworks and 3D printing software.

## Alstom

Software Engineering Intern & Embedded System Engineering Intern

Melbourne, FL

May 2019 - Aug 2019

- Cooperated with Alstom's System Validation Team to perform system tests and review code (primarily in C++ and Python) on Alstom DAU (Data Acquisition Unit), a vital wayside component of the Alstom's Automatic Railway Signaling System; Debugging lower-level program, scanning and hacking the Apache server installed to search for possible bugs which may lead to the fatal crash of the system.
- Developed a C++ testing program for Alstom's Wayside Linux-Based Core ACE board to meet Hardware Serial Test Specifications including multi-CPU communication, I2C, UART, SPI, onboard GPIO connection, Watchdog Timer, and other hardware checks. The testing program includes both lower-level hardware programming and higher-level algorithm programming.

## Projects

### Mechanical Engineering Senior Design Project

Madison, WI; Milwaukee, WI

Milwaukee Tool

Sep 2019 - May 2020

- Designing a glove impact testing fixture to quantitatively measure the impact protection provided by impact-resistant gloves.
- Completing three iterations of CAD model design and FEA analysis, and creating engineering drawings for Milwaukee Tool's workshop to manufacture parts
- Working with resistance-based force sensor circuits and related component.
- Designing and creating ready-to-deliver LabView programs to integrate pneumatic system and data acquisition unit (NI C-DAQ)

### Solidworks Training Design Project

University of Wisconsin-Madison

Madison, WI

Nov 2018

- Designing a drone frame and a drone cover which meets the requirements provided with limited ABS Material using Solidworks and PareToWorks
- Performing FEA structural analysis in Solidworks to ensure the design meets performance and endurance requirement.

## Skills

<b>Programming</b>	Python, C/C++/C#, CUDA, HTML/CSS, Java, JavaScript, Julia, R, SQL.
<b>Engineering/Design</b>	Solidworks, Blender, MSC Adams, ROS, Unity, Unreal Engine, Matlab, Simulink, Rhino, COMSOL Multiphysics
<b>Miscellaneous</b>	Linux, Shell, Latex, Firebase Interface, Windows CMD, Tensor, Unity, Unreal Engine, Tensorflow, OpenCV, Keras

## Contributed Awards

- **NSF Award 1739869, Total \$1,200,000**, CPS: TTP Option: Medium: Identifying, Characterizing, and Shaping Multi-Scale Cyber-Human Interactions in Mixed Autonomous Conventional Vehicle Traffic, September 16, 2019 - September 30, 2023, PI: Soyoung Ahn, Dan Negrut, John Lee
- **NSF Award 1835674, Total \$529,000**, Collaborative Research: Elements:Software:NSCI: Chrono - An Open-Source Simulation Platform for Computational Dynamics Problems, August 1, 2019 - July 31, 2023, PI: Dan Negrut, Radu Serban
- **NSF Award 2317946, Total \$250,000**, Collaborative Research: FW-HTF-R: The Future of Trucking: Pathways to Positive Societal Outcomes, October 1, 2022 - September 30, 2025, PI: David Noyce, Parameswaran Ramanathan, Madhav Chitturi, Xiangru Xu

## Publication

- **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>
- Serban, R, Taves, J, **Zhou, Z.** "Real-Time Simulation of Ground Vehicles on Deformable Terrain." Proceedings of the *ASME 2022 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference. Volume 9: 18th International Conference on Multibody Systems, Nonlinear Dynamics, and Control (MSNDC)*. St. Louis, Missouri, USA. August 14–17, 2022. V009T09A012. ASME. <https://doi.org/10.1115/DETC2022-89470>
- Hu, W., **Zhou, Z.**, Chandler, S., Apostolopoulos, D., Kamrin, K., Serban, R., Negrut, D. Traction control design for off-road mobility using an SPH-DAE cosimulation framework. *Multibody Syst Dyn* 55, 165–188 (2022). <https://doi.org/10.1007/s11044-022-09815-2>
- Hu, W., **Zhou, Z.**, Serban, R., Negrut, D., Using an SPH-based continuum representation of granular terrain to simulate VIPER rover mobility, 2021/10, *Preprint*, [https://www.researchgate.net/publication/358872957\\_Off-Road\\_Rover\\_Mobility\\_Simulation\\_Using\\_a\\_Continuum\\_Representation\\_of\\_Deformable\\_Terrains](https://www.researchgate.net/publication/358872957_Off-Road_Rover_Mobility_Simulation_Using_a_Continuum_Representation_of_Deformable_Terrains)
- Hu, W., **Zhou, Z.**, Serban, R, Negrut, D. "Using an SPH-Based Continuum Representation of Granular Terrain to Simulate the Rover Mobility." Proceedings of the *ASME 2021 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference. Volume 9: 17th International Conference on Multibody Systems, Nonlinear Dynamics, and Control (MSNDC)*. Virtual, Online. August 17–19, 2021. V009T09A028. ASME. <https://doi.org/10.1115/DETC2021-71289>

## Conference Presentation

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- Taves J., Elmquist, A., **Zhou, Z.**, Kissel A., Serban, R, Negrut, D, "Synchronization and Scalability of the Multi-Agent Dynamics Environment SynChrono" *The Joint International Conference on Multibody System Dynamics and The Asian Conference on Multibody System Dynamics*, New Delhi, India, OCT 16-20, 2022.
- **Zhou, Z.**, Hu, W., Serban, R, Negrut, D, "Simulation of Robotic Mechanical Systems and Application in Robot-Terrain Interaction Using Project Chrono" *ASME 2021 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference*, AUG 17-20, 2021.
- Hu, W., **Zhou, Z.**, Serban, R, Negrut, D, "Using an SPH-Based Continuum Representation of Granular Terrain to Simulate the Rover Mobility" *ASME 2021 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference*, AUG 17-20, 2021.