

Phoenix McGuire

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SUMMARY

Lead Physical AI and simulation engineer with 10 years of experience building physics based models, **digital twins**, and **virtual validation** environments for heavy mobile machinery and autonomous systems. Deep expertise spans multibody dynamics, articulated mechanisms, hydraulics, powertrain behavior, vehicle dynamics, kinematics, tire ground interaction, and machine terrain interaction. Hands on work with NVIDIA Newton, Isaac Sim, Omniverse, OpenUSD, Warp, ROS2, Python, and C++ supports **high fidelity simulation**, synthetic data generation, reinforcement learning, **software in the loop** testing, and reduced order modeling. Technical leadership includes setting modeling standards, correlating models with engineering tests and telemetry, guiding multidisciplinary reviews, and balancing fidelity, solver robustness, computational performance, and reuse across machine platforms.

EXPERIENCE

Lead Physical AI Engineer

July 2023 - Present

IronVale Robotics

Pittsburgh, PA

Own technical direction for construction machine digital twins, physics simulation workflows, autonomy validation, reusable subsystem interfaces, and multidisciplinary engineering decisions.

- Set architecture for construction machine digital twins using reusable interfaces and verification gates across platforms.
- Built **NVIDIA Newton** and **Isaac Sim** models for hydraulics, powertrain response, contact, and terrain interaction.
- Correlated proving ground tests and telemetry with models, resolving issues alongside controls and hydraulics specialists.
- Created **reduced order models** with validity ranges for real time control evaluation and **reinforcement learning**.
- Integrated OpenUSD assets, simulated sensors, ROS2 interfaces, and **robotics software** for **software in the loop** testing.
- Mentored simulation engineers through reviews spanning artificial intelligence, autonomy, product, and vendor teams.

Senior Simulation and Robotics Engineer

May 2020 - June 2023

Northstar Mobile Systems

Milwaukee, WI

Developed high fidelity off highway vehicle models and reusable simulation pipelines connecting machine behavior, autonomy software, sensor data, and virtual validation.

- Developed multibody models for articulated joints, driveline behavior, hydraulic implements, chassis motion, and ground interaction.
- Created **Python** and **C++** utilities for parameter sweeps, regression checks, telemetry alignment, and model reporting.
- Connected machine models with **autonomy** software and virtual sensors for repeatable navigation evaluation before testing.
- Applied **Omniverse**, Isaac Sim, Warp, and **OpenUSD** to reusable scene and asset workflows with traceability.
- Correlated maneuver, load, and hydraulic response against instrumented machine data for design review decisions.
- Evaluated simulation technologies and presented adoption recommendations based on coverage, integration effort, and runtime performance.

Machine Dynamics Engineer

June 2017 - April 2020

Vector Dynamics Lab

Madison, WI

Created CAE and **multibody dynamics** models supporting mobility, stability, mechanism studies, controls prototypes, and validated simulation reuse for heavy equipment programs.

- Created **CAE** and multibody models for mobility, stability, and mechanism studies supporting heavy equipment programs.
- Modeled kinematic chains, rigid bodies, tires, terrain contact, hydraulic response, and powertrain loads.
- Wrote C++ components and Python scripts for configuration, post processing, validation, and engineering visualization.
- Exposed simulated actuator, state, and sensor interfaces for **software in the loop** controls experiments.
- Compared predictions with bench and field measurements, isolating sensitivity and numerical issues affecting convergence.
- Produced validation evidence enabling mechanical, controls, and test engineers to reuse simulation assets.

Simulation Engineer

June 2016 - May 2017

Lakefront Engineering Analytics

Cleveland, OH

Developed physics based models and analysis tools for articulated assemblies, vehicle subsystems, early product concepts, and repeatable engineering studies.

- Developed physics based models for articulated assemblies and vehicle subsystems from drawings and test inputs.
- Executed dynamics studies covering loads, motion, stability, and component interactions for early product concepts.
- Built Python tools for batch execution and result comparison across repeated simulation cases.
- Mapped model outputs to test channels, identifying measurement gaps and documenting engineering assumptions.

- Investigated solver instability through controlled experiments, improving numerical robustness before design use.
- Maintained versioned model packages and documentation so analysts could reproduce validated configurations.

PROJECTS

Construction Machine Digital Twin 📅 2024

Created a reusable virtual machine environment combining physics models, simulated sensors, OpenUSD assets, ROS2 interfaces, and autonomy validation workflows.

Reduced Order Model Framework 📅 2023

Built reduced order modeling methods that supported real time controller evaluation, reinforcement learning, virtual validation, and documented lifecycle management.

Terrain Interaction Simulation 📅 2022

Developed machine terrain interaction studies covering tire contact, articulated motion, hydraulic implements, powertrain loads, and mobility behavior.

LEADERSHIP & AWARDS

- Technical leadership recognition for establishing reusable digital twin standards across construction machine simulation programs.
- Engineering innovation recognition for reduced order modeling and real time reinforcement learning workflows.
- Peer leadership recognition for mentoring simulation engineers and guiding multidisciplinary design reviews.

EDUCATION

Master's Degree in Mechanical Engineering

2016

Carnegie Mellon University GPA: 4.0

Pittsburgh, PA

Coursework: Multibody dynamics, robotics simulation, vehicle dynamics, control systems

Bachelor's Degree in Mechanical Engineering

2014

The Ohio State University GPA: 4.0

Columbus, OH

Coursework: Mechanics, kinematics, hydraulics, machine design

CERTIFICATIONS

- NVIDIA Deep Learning Institute, Fundamentals of Robotics Simulation 📅 2025
- ROS2 Advanced Developer Training 📅 2024

TECHNICAL SKILLS

- **NVIDIA Simulation:** NVIDIA Newton, Isaac Sim, Omniverse
- **NVIDIA Physics Tools:** Warp, Isaac Lab, PhysX
- **Programming Languages:** Python, C++, Bash
- **Robotics Middleware:** ROS2, DDS, sensor interfaces
- **Digital Twin Systems:** OpenUSD, virtual environments, machine models
- **Mechanical Dynamics:** Rigid body dynamics, multibody dynamics, articulated systems
- **Machine Systems:** Hydraulics, powertrain systems, vehicle dynamics
- **Terrain Modeling:** Tire ground interaction, terrain contact, mobility analysis
- **AI Simulation:** Reinforcement learning, synthetic data, autonomy validation
- **Validation Methods:** Software in the loop, telemetry correlation, regression testing
- **Model Reduction:** Reduced order models, real time analysis, lifecycle management
- **Engineering Analysis:** CAE, kinematics, solver robustness

SKILLS

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|-----------------|-------------|----------------------|--------------------------|
| • NVIDIA Newton | • Isaac Lab | • Digital twins | • Vehicle dynamics |
| • Isaac Sim | • Python | • Multibody dynamics | • Reinforcement learning |
| • Omniverse | • C++ | • Hydraulics | • Synthetic data |
| • OpenUSD | • ROS2 | • Powertrain systems | |

PROFESSIONAL AFFILIATIONS

- Association for Computing Machinery, professional member focused on robotics simulation and physical artificial intelligence.

- Society of Automotive Engineers, professional member focused on vehicle dynamics, off highway equipment, and mobility systems.

LANGUAGES

- English (Native)
- Spanish (Intermediate)

ADDITIONAL INFORMATION

Work Status : Authorized to work in United States. No sponsorship required.

REFERENCES

AVAILABLE ON REQUEST