

Alireza Falah

ROBOTICS ENGINEER (PERCEPTION & SIMULATION)

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Work Experience

AUMOVIO Inc.

Budapest, Hungary

4D Computer Vision & Neural Rendering - Deep Learning Research Intern

Apr 2026 - Present

- Achieved **millimeter-level** accuracy in **3D Gaussian reconstructions** of parking scenarios by **fusing** multi-view automotive **images with LiDAR depth supervision** for novel view synthesis.
- Established a baseline for environmental awareness using SOTA foundation models to **detect and segment objects** in rendered 2D images from the reconstructed 3D scene, followed by **lifting the 2D segmentation into 3D space** for enhanced scene understanding (2D-to-3D Object Lifting).
- Extended static scene reconstruction to a dynamic **4D representation** using object tracking, enabling **temporal scene understanding** for autonomous driving applications.
- Extracted individual assets from reconstructed scenes, assigned motion vectors, and transferred them into other scenes, enabling **dynamic scene composition and 4D scene understanding**.
- **Tech Stack:** Python, PyTorch, 3DGS, SOTA Foundation Models, Computer Vision, Multi-View Geometry, COLMAP, LiDAR/Camera Fusion.

HUMDA Lab Nonprofit Ltd.

Budapest, Hungary

AI Researcher and Simulation Engineer

Feb 2024 - Aug 2025

- Led the integration of **aiSim (Stellantis)** with the company's autonomous driving software (developed in **C++, Python, and ROS2**) and engineered custom **virtual sensors in aiSim for synthetic data generation**.
- Developed and maintained a high-fidelity racing simulation in **MuJoCo** and **Brax**, and used **reinforcement learning** to generate optimal, dynamically feasible trajectories, which was successfully used at the **A2RL 2025 Sim Challenge**.
- Maintained a **DevOps pipeline** using **GitHub Actions, Docker, and Azure VMs**. This pipeline automated the validation of the core autonomous software by running **Pytest-based quality gate scenarios** (e.g., tunnel passing, time trials) within a **containerized simulation**, ensuring continuous integration and **robust performance for every commit**.
- **Technical Skills:** C++, Python, ROS2, JAX, MuJoCo, Brax, Vehicle Dynamics, Docker, Pytest, DevOps, CI/CD, OpenCV, GitHub Actions, Azure, Git, Linux, CUDA, Synthetic Data Generation.

Deep Learning Center of Iran

Tehran, Iran

Autonomous Vehicles Researcher

Jan 2020 - Aug 2022

- Researched and implemented **high-performance perception modules** for autonomous racing vehicles, specifically optimizing **object detection and tracking** algorithms for real-time performance using **Python** and **ROS2**.
- Presented technical findings on perception architecture to engineering stakeholders, directly contributing to the organization's **autonomous technology roadmap**.
- **Tech Stack:** C++, Python, ROS2, OpenCV, Computer Vision, Object Detection (YOLO/SSD), Kalman Filters, Linux, Git.

Mapna Turbine Engineering and Manufacturing Company

Karaj, Iran

Mechanical Engineer (Simulation & Analysis)

Sep 2018 - Nov 2019

- Engineered Air Cooled Condensers (ACCs) by developing detailed Finite Element (FEA) models in Ansys, performing structural optimization to withstand thermal loads.
- Executed complex **numerical analysis**, solving governing **Partial Differential Equations (PDEs)** for nonlinear stress and stiff systems of **ODEs** for **transient thermal dynamics to validate simulation accuracy**.
- Modeled large-scale S-CO2 power cycles using Aspen Plus, analyzing system efficiency through rigorous process simulation.
- **Tech Stack:** Ansys (FEA), Matlab, Simulink, Aspen Plus, Numerical Analysis (PDEs/ODEs), Autodesk Inventor.

Education

Eötvös Loránd University (ELTE)

Budapest, Hungary

Ph.D. in Computer Science (Specialization: Computer Vision)

- **Stipendiwhereum Hungaricum Scholarship** recipient.
- **Research Focus: System Design and Computer Vision for Industry 4.0.** Designing autonomous optical inspection systems, focusing on: (1) High-fidelity **CNC tool condition monitoring** using **classical computer vision pipelines**, and modern **Deep Learning techniques**. (2) **Autonomous 3D reconstruction** of shiny tools and manufactured parts for **CAD model retrieval** by improving existing Shape from Shading (SfS) using Prior Knowledge and **Autoencoders**.
- Spearheaded the creation and publication of the **ELTE-TCM-46k dataset**, a novel collection of 46,000+ high-resolution images for CNC tool condition monitoring

Eötvös Loránd University (ELTE)

Szombathely, Hungary

M.S. in Mechanical Engineering (Specialization: Automation and Industry 4.0)

- **Stipendium Hungaricum Scholarship** recipient. **GPA:** 4.43/5.00
- **Thesis: Vision-Based Tool Monitoring.** Engineered an end-to-end **Computer Vision pipeline** using **OpenCV** and **Python**. Integrated industrial hardware (Basler) and implemented **hybrid signal processing** and **feature extraction** algorithms to quantify tool health. Resulted in the **ELTE-TCM-46k dataset** and publication in world Q1 journals.
- **Robotics Competition (TechTogether):** Secured 2nd Place solving industrial challenges for **Fanuc** and **Kuka** robots. Optimized robotic trajectories and integrated sensor feedback for pick-and-place tasks. Awarded special university scholarship for **consistent high performance** in competitive engineering events.
- Received training from industry experts at **Schaeffler** and **TDK**. Key courses: Computer Vision, Microcontroller Based Device Development, **Embedded Systems Programming (Assembly/Low-Level CPU-Specific)**, Industrial Communications, Digital Factory protocols.

Semnan University

Semnan, Iran

B.S. in Mechanical Engineering

- **Thesis:** Simulation utilizing **Finite Element Methods (FEM)** for deformable barrier testing. (Supervisor: Dr. Amir Najibi)
- Gained expertise in 3D Modeling, Solid Properties, Computational Fluid Dynamics, Finite Element Methods, Control and Automation, Heat Transfer, and Thermodynamics.

Projects

Foundation Models & Embodied AI Reimplementations

Budapest, Hungary

Personal R&D Project

2026

- **LLM Foundations:** Reimplemented **BERT** and **GPT** architectures from scratch to deepen expertise in transformer architectures.
- **3D Vision (VGGT):** Reimplemented the **Visual Geometry Grounded Transformer (VGGT)** architecture. This builds on my industrial experience in 3D scene reconstruction. From multi-view image sets, 3D scene attributes (depth, camera poses, point tracks) were inferred directly using Vision Transformers (ViT).
- **Research Interests:** Particularly interested in **Vision-Language-Action (VLA) models** for their potential to bridge the gap between perception and action in embodied intelligence. This is a **natural progression as it connects all my previous industrial experiences**.
- **Tech Stack:** Python, PyTorch, Hugging Face Transformers, PEFT/LoRA, ViT, Embodied AI.

Honors & Certifications

Abu Dhabi Autonomous Racing League (A2RL)

Yas Marina Circuit, Abu Dhabi, UAE

5th Place – International Autonomous Racing Competition

2024

- Achieved **5th Place** globally with the HUMDA Lab team, competing for a **\$2.5 Million prize pool** against elite research universities (e.g., TUM, UNIMORE).
- Executed critical **simulation-based validation** of vehicle behavior, ensuring control strategy safety and stability for the **Dallara Super Formula SF23** prior to track deployment.

Scientific Student Association (TDK)

Eötvös Loránd University

2nd Place (University Level) – National Finalist

2023

- Awarded **2nd Place** for Master’s thesis in the Informatics section, securing qualification for the **National Scientific Students’ Associations Conference (OTDK)**.
- Thesis selected for publication in the university’s academic journal based on research excellence.

IBM Developer Skills Network

Online, Coursera

DevOps Essentials Professional Certificate

Issued 2026

- Covers Continuous Integration (CI/CD), Containerization (Docker), and Monitoring. [\(View Badge\)](#)

Publications & Scientific Contributions

JOURNAL ARTICLES

Tool Condition Monitoring in CNC Systems: A Hybrid Computer Vision and Signal Processing Approach

Alireza Falah, Mátyás Andó, Bálint J. Szekeres

The International Journal of Advanced Manufacturing Technology (2025). 2025

Novel and Cost-Effective CNC Tool Condition Monitoring Through Image Processing Techniques

Alireza Falah, Mátyás Andó

Discover Applied Sciences (2025). 2025

CONFERENCE PROCEEDINGS

Autonomous Racing Competitions: A Review of Platforms, Software Development, and Sustainability Contributions

Zalán Demeter, Alireza Falah, Levente Puskás

Proceedings of the Conference on Sustainability (COS2024), 2024, Győr, Hungary

DATASETS

ELTE-TCM-46k: A CNC Tool Condition Image Dataset

Alireza Falah, Soninkhuu Baatarchuluun, Mátyás Andó, Béla Szekeres

Hugging Face repository, 2025

Skills

Languages & Programming	Python (JAX, PyTorch, Scikit-learn, NumPy), Modern C++, CUDA, oneAPI, Linux, Matlab
Robotics & Sim	ROS2 (Humble), MuJoCo, Brax, Nvidia Isaac Sim, aiSim, Vehicle Dynamics, Synthetic Data Gen, URDF/SDF
Math & Physics	Numerical Methods, Monte Carlo, Rigid Body Dynamics
DevOps & Tools	Docker, GitHub Actions, CI/CD, Azure, Linux (Bash), Git, Foxglove, Microcontrollers (Arduino/STM32)
Soft Skills	Adaptability, Cross-Functional Collaboration, Communication, Creativity, Critical Thinking, Presentation Skills

References available upon request.