

# Andrei-Carlo Papuc

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**Research interests:** computer vision, deep learning, machine perception, planning and decision-making under uncertainty, optimal control, and (reinforcement) learning for control, all within the realm of robotics.

## Education

### Delft University of Technology

*Delft, The Netherlands*

M.Sc. in Robotics

*Sept 2022 - Current*

- **Courses:** Machine Learning for Robotics, Deep Learning, Computer Vision by Deep Learning, Machine Perception, Planning & Decision Making, Model Predictive Control, Intelligent Control Systems, Cyber Risk Management, Deep Reinforcement Learning

### Delft University of Technology

*Delft, The Netherlands*

B.Sc. in Aerospace Engineering

*Sept 2018 - Jul 2022*

- Minor in Computational Science and Engineering
- **Relevant Coursework:** Object Oriented C++, Control Theory; Systems Design; Parallel Computing; Computational Modelling; Numerical Methods for PDE's; Scientific Programming; Simulation, Verification & Validation.

## Work Experience

### HUBS | On-demand Manufacturing

*Amsterdam, The Netherlands*

R&D Software Engineer

*May 2021 - Jul 2022*

- Led the optimization and maintenance of meshing and conversion algorithms, ensuring consistent and accurate results across diverse 3D CAD formats and facilitating seamless data conversion.
- Developed robust C++ codebase to execute intricate mesh analysis on 3D CAD models, effectively evaluating complex geometries and contributing to precise engineering insights
- Performed feature engineering, model training and hyperparameter search for machine learning pricing algorithms using insights from mesh analysis tools.
- **Technical Skills:** C++, CMake, PyTorch, NumPy, Matplotlib, Pandas, Scikit-learn, Rust

### MX3D | Robotic 3D Metal Printing

*Amsterdam, The Netherlands*

Full Stack Software Developer

*May 2019 - Aug 2020*

- Developed high-level geometry manipulation algorithms for meshes using Python, Trimesh, and Numpy, resulting in different slicing procedures for wire arc printing, leading to 70% growth in user engagement
- Created a web app simulator for robotic arms with live feedback for progress and planning.
- Contributed to mesh analysis algorithms such as naked edge and overhang detection.
- **Technical Skills:** Python, Trimesh, Numpy, React, Typescript, NodeJS, Electron, ThreeJS, Python, Django, Express

## University Projects

### Enhancing autonomous driving: leveraging frame-based foundation models for improved pedestrian detection and sensor fusion

*Delft, NL*

Course project of Computer Vision by Deep Learning (CS4245) - graded 10/10

*Jun 2023*

- Addressed questions regarding leveraging foundational models' implicit knowledge for accurate 2D pedestrian detection, evaluated 3D pedestrian detection performance relative to autonomous vehicles, compared learned and manual sensor fusion, and assessed foundational models for real-time use in autonomous vehicles in a comprehensive blog post.

### Autonomous legged robot solution for efficient lost item retrieval

*Delft, NL*

Course project of Multidisciplinary Project (RO47007) with TNO - graded 8.5/10

*Jun 2023*

- Developed perception and planning algorithms in Python ROS for the Boston Dynamics Spot robot.
- Utilized fine-tuned YOLO for object recognition, employed depth-based SLAM through Rao-Blackwellised particle filtering, incorporated both global and local RRT algorithms for navigation, implemented a finite state machine, and designed an intuitive GUI for user interaction.

### A model predictive control approach for trajectory tracking of quadrotors

*Delft, NL*

Course project of Model Predictive Control (SC42125) - graded 10/10

*May 2023*

- Developed MPC approach for precise quadrotor trajectory tracking by enhancing mathematical model with aerodynamic effects, ensuring real-world accuracy and disturbance avoidance.
- Verified controller's effectiveness by showcasing trajectory tracking, constraint satisfaction, and stability through Lyapunov analysis with disturbance rejection validation.

## Reproduction of deep learning paper on event camera processing

Delft, NL

Course project of Deep Learning (CS4240)

May 2023

- Reproduced partial results of the paper *AEGNN: Asynchronous Event-based Graph Neural Networks*
- Adapted the preprocessing and training pipelines to perform two types of experiments: changing convolutions and hyperparameters evaluation.

## Obstacle driven RRT implementation for quad-rotor motion planning

Delft, NL

Course project of Planning & Decision Making (RO47005) - graded 9.5/10

Jan 2023

- Introduced biased RRT\* for efficient indoor path planning: Numerical analysis demonstrates advantages in densely obstructed spaces.
- Highlighted potential for dynamic indoor settings: Enables rapid path adaptation due to environmental changes, and suggested integration with MPC for comprehensive quad-rotor motion planning.

## Design of a drone swarm to measure the wind field and temperature stratification in a wind farm

Delft, NL

Bachelor's Thesis

Jan 2022

- Formulated and solved the problem as the k travelling salesman optimisation problem (TSP) in the swarm design.
- The goal of this project was measure the atmospheric conditions with full three-dimensional coverage of a wind farm to optimize its operational performance and control.

## Developing analytical models for dynamic analysis of lattice structures

Delft, NL

Course project of Final Minor Project (TW3725TU)

Jan 2021

- Co-authored a research paper on Spectral Element Methods in a cross-faculty team of 4.
- Implemented a new method of analysis for the Dep. Precision and Microsystems Engineering, improving the accuracy in comparison to FEM by 15% and speed by 30% with MPI, Python, GMesh, Numpy

## Robotic particle image velocimetry for position reconstruction of a smart rotor model

Delft, NL

Course project of Test, Analysis & Simulation (AE2224)

Jun 2020

- The purpose of this research paper was to present a method which helps in determining the model position and orientation of a Smart Rotor Model (SRM) in a wind tunnel experiment using robotic particle image velocimetry (RPV) measurements of structural markers.

## Activities and Leadership

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### Makerspace Delft

Delft, NL

Facilities Manager

Oct 2020 - Apr 2021

- Co-founded a shared working space for students and startups embarking on innovative engineering projects. Raising interest from TU Delft and Municipality of Delft, resulting in a 15k euro grant.
- Designed and assembled the space, organizing acquisition, maintenance of tools and machinery.

### International Computer High School of Bucharest

Bucharest, RO

Student professor

Jan 2018 - Jun 2018

- Taught short courses on engineering to 20 first and second year students on CAD, Physics, Programming.

## Skills

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|-------------------------|---|
| <b>Computational</b>    | C++, C, CMake, Make, Rust, CVXPY, GUROBI                                  |
| <b>Machine Learning</b> | Python, PyTorch, Tensorflow, NumPy, Matplotlib, Pandas, Scikit-learn, ROS |
| <b>Miscellaneous</b>    | React, Typescript, Hugo, NodeJs, Electron, ThreeJS, Git, LaTeX, Markdown  |
| <b>CAD</b>              | Rhino, CATIA, Fusion360   |

References available upon request.