

# Vlad Niculescu, PhD

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## Summary

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**Robotics and AI Researcher** | Experienced in Localization, Computer Vision, and Embedded Systems. Proven success in developing real-time autonomous solutions for robotic platforms and resource-constrained AI systems.

## Work Experience

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**Scientific Assistant / Doctoral Student**, ETH Zürich – Zürich, Switzerland Jan 2020 – Dec 2024

- Research on enabling autonomous capabilities such as localization, mapping and navigation onboard resource-constrained, centimeter-size UAVs, leveraging sensor fusion algorithms
- End-to-end deployment of deep learning vision models for perception on edge devices: from model training to quantization, deployment, and real-time inference onboard the UAVs
- Algorithm optimization for efficient execution on RISC-V parallel platforms (onboard the UAVs)

**Control Systems Intern**, Fotokite – Zürich, Switzerland Sep 2018 – Feb 2019

- Implemented new features for a drone onboard pilot, tuned motor controllers, and evaluated the performance of various motors to optimize flight efficiency leveraging ROS for data acquisition

**Electrical Lead**, Swissloop – Zürich, Switzerland Jul 2018 – Aug 2019

- I led the electrical team of Swissloop, a student project within ETH Zürich which developed a self-propelled vehicle that reached 252 km/h in a mile-long vacuum tube at SpaceX Hyperloop Competition

**Student Developer**, Google Summer of Code Jul 2017 – Sep 2017

- I developed a smart switching regulator for the AXIOM camera system working with Apertus. I have designed the circuit board and developed the HDL code of the regulator's control system algorithm

**Embedded Applications Intern**, Microchip Technology – Bucharest, Romania Jul 2015 – May 2017

- Firmware developer for data acquisition systems. I designed high-precision power meters featuring PIC32 microcontrollers. In addition, I designed the schematics and organized the testing setup

## Education

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**ETH Zürich**, PhD in Electrical Engineering Jan 2020 – Jul 2024

- Obtained my PhD under the supervision of Prof. Dr. Luca Benini in the Integrated Systems Laboratory
- **Thesis title:** Efficient and Lightweight Localization, Perception, and Mapping for Resource-Constrained UAVs

**ETH Zürich**, Master of Science in Robotics, Systems and Control. GPA 5.22/6 Sep 2017 – Aug 2019

- **Thesis title:** Autonomous Drones and Wireless Sensor Networks Exploiting UWB and Wake up Radios

**Politehnica Bucharest**, Bachelor of Science in Electrical Engineering. GPA 9.71/10 Sep 2013 – Jul 2017

## Skills

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**Robotics:** SLAM, Perception, Localization, State Estimation, Sensor Fusion

**Computer Vision:** Filtering, Depth Estimation, Tracking, Optical Flow, Object Detection, Semantic Segmentation

**Embedded Systems:** Algorithm Optimization, Embedded (Parallel) Programming, RTOS, Hardware Design

**Programming:** C/C++, Python, Matlab, Verilog, Assembly

**Languages:** Romanian: mother tongue. English: fluent. Spanish: basic

## Awards

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- 2<sup>nd</sup> place at SpaceX Hyperloop Pod Competition 2019
- 1<sup>st</sup> place at Microsoft Imagine Cup National Phase Quarter finalist in the World Phase - Seattle 2017.
- Top 10 in MakeMIT 2017 hackathon, MIT – Boston 2017
- 1<sup>st</sup> place at International Robotics Contest “Robochallenge”, Bucharest 2015

## Research Projects

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### Onboard SLAM for Tiny Robots

Git, Video

- developed a lightweight end-to-end SLAM engine that uses depth measurements (e.g., LiDAR, ToF)
- graph-based trajectory optimization and scan-matching for loop closure
- linear algebra operations accelerated using a parallel RISC-V SoC
- extended to robot swarms, performing collaborative mapping

### Vision-based Navigation for Miniature Drones

Git, Video

- enabled deep learning-based autonomous navigation onboard a 30 g drone
- the CNN model was quantized to 8-bit and deployed on a multicore SoC
- enabled multimodal learning, fusing RGB images with ToF depth frames

### Deep Learning for AR/XR Smart Glasses

- designed a gesture-based wake-up system for smart glasses, recognizing specific dynamic gestures to exit low-power mode and initiate heavy processing tasks
- enabled the execution of concurrent deep learning models, supporting multiple modalities such as keyword spotting, object detection, and eye gazing

## Main Publications

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**NanoSLAM: Enabling Fully Onboard SLAM for Tiny Robots**, in IEEE Internet of Things Journal 2024

**Energy-efficient, Precise UWB-based 3-D Localization of Sensor Nodes with a Nano-UAV**, in IEEE Internet of Things Journal 2022

**Improving Autonomous Nano-Drones Performance via Automated End-to-End Optimization and Deployment of DNNs**, in IEEE Journal on Emerging and Selected Topics in Circuits and Systems 2021

**Towards a Multi-Pixel Time-of-Flight Indoor Navigation System for Nano-Drone Applications**, in IEEE International Instrumentation and Measurement Technology Conference (I2MTC) 2022

**Automated Tuning of End-to-end Neural Flight Controllers for Autonomous Nano-drones**, in IEEE International Conference on Artificial Intelligence Circuits and Systems (AICAS) 2021

**Robust and Efficient Depth-based Obstacle Avoidance for Autonomous Miniaturized UAVs**, in IEEE Transactions on Robotics, 2023

**A Relative Infrastructure-less Localization Algorithm for Decentralized and Autonomous Swarm Formation**, in IEEE IROS 2023

**Tiny-PULP-Dronets: Squeezing Neural Networks for Faster and Lighter Inference on Multi-Tasking Autonomous Nano-Drones**, in IEEE AICAS 2022

## Teaching

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ETH Zürich, Embedded Systems with Drones

Mar 2021 – Jun 2023

Set the foundation of a new course that teaches the fundamental principles on how drones work, provides an introduction to embedded devices and involves coding exercises for state estimation and flight control algorithms.