Arion Zimmermann
MSc Electrical Engineering

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Education

MSc Electrical Engineering
EPFL, Switzerland, 2021-2024

Minor in Aerospace. Research focus on innovative localization and perception strategies for space-based platforms. GPA 5.64/6.

BSc Electrical Engineering
EPFL, Switzerland, 2018-2021

Research focus on redundant switched-mode power supplies for planetary rovers. GPA 5.53/6.

Research experience

Research Engineer
Caltech, United States, Nov. 2024 – Present

Design, implementation and validation of robust perception and localization algorithms for the Caltech Racer autonomous racecar.

Conference Paper
Milan, Italy, Oct. 2024

A. Zimmermann, S.-J. Chung, F. Hadaegh, "COFFEE: A Shadow-Resilient Real-Time Pose Estimator for Unknown Tumbling Asteroids using Sparse Neural Networks", *Proc. 75th International Astronautical Congress*. Link.

Visiting Student Researcher
Caltech, United States, Feb. – Aug. 2024

MSc Thesis: Pose estimation of unknown tumbling asteroids supervised by Professor Soon-Jo Chung.

Research Assistant
EPFL, Switzerland, Feb. – Dec. 2022

Research on ultra-wideband angle-of-arrival localization strategies and experimental testing supervised by Professor Andreas Burg.

Teaching Assistant
EPFL, Switzerland, 2020-2022

TA for *Physics III: Electrodynamics* supervised by Professor Dirk Grundler.

TA for *Microcontroller Systems* supervised by Dr Alexandre Schmid.

TA for *Electronics II: Analog amplifiers* supervised by Dr Adil Koukab.

Industry experience

Systems Engineering Intern
SpeQtral, Singapore, Sep. – Dec. 2023

Firmware system architecture and development for a Quantum Key Distribution LEO satellite.

EPFL Xplore
EPFL, Switzerland, 2020-2023

Various roles at EPFL Xplore, a student-led association designing rovers, drones, and legged robots and yearly participation in the ERC international robotics competition in Poland.

Co-founder (2020)

Rover Systems Engineer (2020-2021)

Project Manager & Vice-President (2021-2022)

Drone Systems Engineer (2022-2023)

EPFL Rocket Team
EPFL, Switzerland, 2019-2021

Various roles at EPFL Rocket Team, a student-led rocketry association designing sounding rockets and yearly participation in the EuRoC international rocketry competition.

Avionics Engineer (2019-2020)

Avionics Team Leader (2020-2021)

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Skills

Electronics: Altium, KiCad, LTSpice, LTPowerCAD, Vivado, Quartus, VHDL, Verilog, SystemVerilog, Cadence, ModelSim, Verilator, SDR, GNU radio.

Software: C, C++, FreeRTOS, ZephyrRTOS, Python, MATLAB, Swift, Kotlin, Java, Microservices, React, Javascript, HTML, CSS, Node.js, SQL, Git, CI, PyTorch, CUDA, TensorRT

Robotics: ROS, ROS2, PCL, CNN, GNN, SSM, Factor Graphs, SLAM, Gazebo, Fusion 360, Capella, Kalman Filtering, MPC.

Languages: English C2, German fluent, French native.

Achievements

ERC Robotics Competition

Kielce, Poland, September 2023

3rd place at the ERC world finals with the special prize for the best autonomous robotic arm design and operation.

Startup Weekend Hackathon

Lausanne, Switzerland, May 2023

2nd place at the startup week-end Lausanne hackathon. Development of a business plan to automatize digital marketing through an LLM.

Lauzhack Hackathon

Lausanne, Switzerland, November 2022

Participation in the Lauzhack international hackathon. Development of a decentralized music content sharing platform (DDS and blockchain).

ERC Robotics Competition

Kielce, Poland, September 2022

2nd place at the ERC world finals with the special prize for the best autonomous navigation software.

EuRoC Rocketry Competition

Ponte de Sor, Portugal, October 2021

1st place at the EuRoC international rocketry competition. Design and launch of a "student researched and developed" hybrid rocket reaching 10k feet.

ERC Robotics Competition

Kielce, Poland, September 2021

3rd place at the ERC world finals with the special prize for the best science plan, its execution and the insightful results it yielded.

Athena Program Scholarship

Lausanne, March 2018

$10k scholarship awarded by the University of Geneva for the highest grade in Electrodynamics undergraduate course.

Piano Competition

Lausanne, February 2018

1st prize *cum laude* at the Schubert piano competition organized by the Geneva Music Conservatory.

Special Prize

Lausanne, November 2017

Prize *Coup de Cœur* of $500 awarded by the high-school's parents' council APEC for the design and development of a campus mobile application.

MIT Primes

Lausanne, July 2017

MIT Primes-Switzerland program in mathematics. Knot theory lectures jointly organized by the MIT and SwissMAP.

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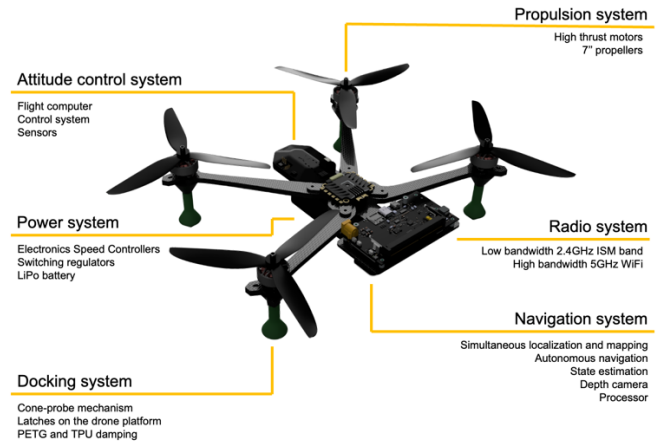
Robotics projects

Rover

EPFL Xplore is an EPFL student association which develops robotic systems to participate every year in the ERC robotics competition. I oversaw the systems engineering and project management aspects of the Rover project. During the first year, my duties consisted in defining the concept of operations, writing the requirements, defining a software/electrical system architecture, and creating an assembly, integration, and testing plan. For the second year though, I was promoted to the project manager role, where I had the responsibility of maintaining the project's budget and timeline. Implicitly, this role taught me many soft skills, such as quick decision-making, leadership and initiative.

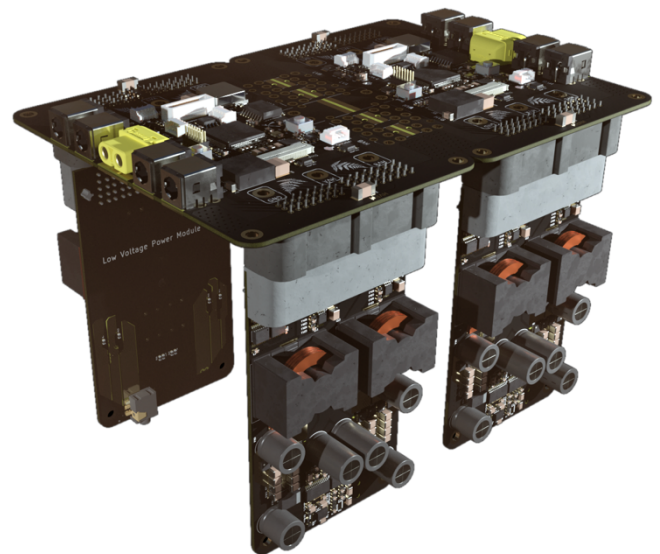*"Astra" rover, 2nd at the ERC 2022 world finals with the best autonomous navigation*

Drone

In February 2023, the ERC robotics competition committee decided to include the design and development of a drone that had to take-off from and land on the rover. An agile team of 4 students was formed to address the need of designing a drone in less than 6 months. I mainly worked on the system architecture and the autonomous navigation software. At ERC 2023, the drone we developed flew successfully, and thus provided useful scientific data to the team.

Attitude control system
Flight computer
Control system
Sensors

Propulsion system
High thrust motors
7" propellers

Power system
Electronics Speed Controllers
Switching regulators
LiPo battery

Radio system
Low bandwidth 2.4GHz ISM band
High bandwidth 5GHz WiFi

Navigation system
Simultaneous localization and mapping
Autonomous navigation
State estimation
Depth camera
Processor

Docking system
Cone-probe mechanism
Latches on the drone platform
PETG and TPU damping

"Brokkoly" autonomous drone, providing aerial imagery at the ERC 2023 world finals

Power system

Between 2020 and 2023, I was also in charge of designing, manufacturing, and testing the rover's power system, which provides and monitors the energy delivered to all electronic parts of the robot. After many years of iterations, the design converged to a high-power fully redundant and programmable power system.

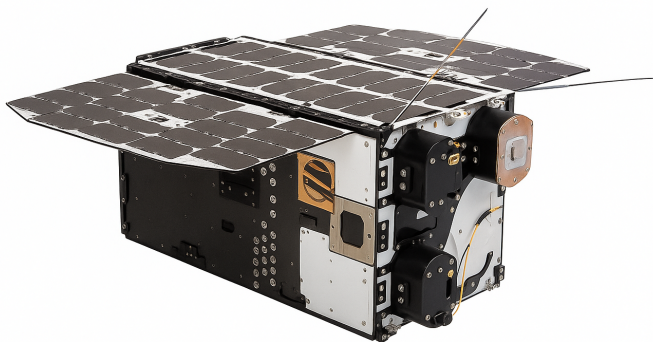*"Pollux III" motherboard and its power modules, powering the 2023 "Kerby" rover*

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Electronics projects

QKD satellite firmware

SpeQtral is a Quantum Key Distribution startup based in Singapore aiming to create a space-based distribution network that will ensure absolute data security for governments, corporations, and tomorrow's most sensitive communications.

During my Systems Engineering internship in 2023, I worked on the validation of the SpeQtre satellite by designing thermal models and operating them in a TVAC. Most importantly, I designed the firmware systems architecture, developed and validated most of it for the SpeQtral-1 satellite, scheduled to launch in 2026.
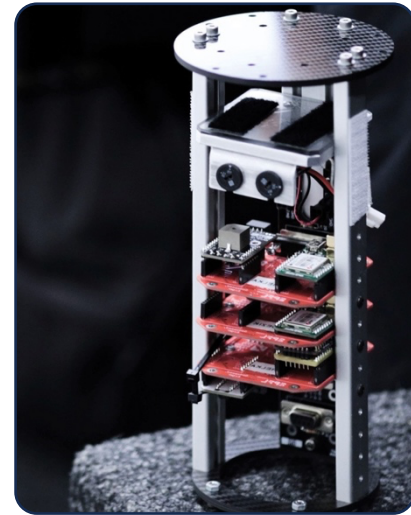

BellaLui II Avionics

Rocket avionics

Since 2017, the EPFL Rocket Team designs rockets and participates in rocketry competitions, such as the Spaceport America Cup in Utah and EuRoC in Portugal. In 2020, I was the team leader of the Avionics subsystem, which developed all the electronic components related to the ignition, telemetry, state estimation and thrust control of the hybrid rocket.


SpeQtral-1 QKD Satellite

UWB AoA localization system

During my graduate studies, I was hired by the Telecommunications Circuits Laboratory at EPFL to research novel localization systems that could be used on the lunar surface, without the need for a costly GNSS constellation.

There, I proved that by broadcasting a rotating high bandwidth signal, we could retrieve the signal's direction-of-arrival through a phase-based processing of the Doppler shift due to the signal's rotation. This localization strategy could theoretically outperform standard radar localization technologies in terms of angular resolution and multipath error.

Successful launch of the BellaLui II hybrid rocket at the EuRoC 2021 competition

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Software projects

Autonomous racecar algorithms

In 2024, I oversee the perception subsystem of the CAST Racer autonomous racecar participating in the Indie Autonomous Challenge. The perception task consists in detecting the competitor's racecars robustly and consistently using the LiDAR and stereo camera data.
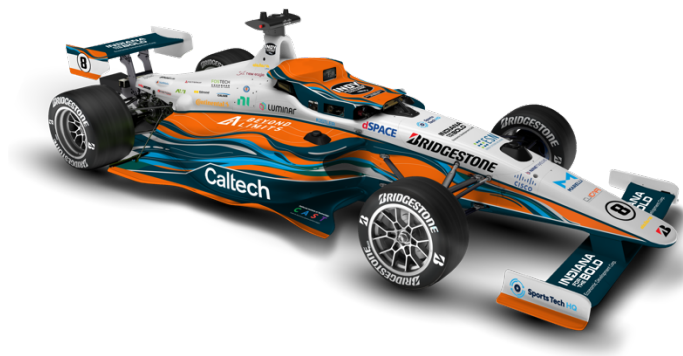
Communication protocol

The *RoCo* Rover Communication protocol was developed in 2020 and was the first piece of software developed for EPFL Xplore. It allowed embedded systems with very few resources to communicate with one another through a common protocol.

The advantage of this communication system was its light weight, as it only used static memory allocation but still implemented a publisher-subscriber model, similar to the more complex Robotic Operating System (ROS).

In addition, this very low latency protocol reduced the reception delay to no more than 100μs between any pair of endpoints. This proved to be particularly useful for drones, as a delay in the sensor acquisition pipeline could result in a dangerous instability in the drone's control system.

Until today, the RoCo protocol is used in all of EPFL Xplore's robots.

Language learning application

During my high-school studies, I developed a passion for ancient languages, such as Latin and ancient Greek, which I chose as language options for my curriculum.

In 2019, I developed the *Lexis* language learning application. Common flashcard apps are indeed unsuited for ancient languages because there is only the need to translate from ancient languages to modern languages and not vice-versa.

Lexis focused on teaching ancient language vocabulary (Latin and ancient Greek) by using machine learning to predict how well a given word was memorized and displaying it accordingly.