Albert Gassol Puigjaner

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EDUCATION

ETH Zurich — Zurich, Switzerland
MSc in Robotics, Systems and Control; GPA: 5.6/6 — *September 2021 - November 2023*
Courses: *Probabilistic Artificial Intelligence, Machine Perception, Vision Algorithms for Mobile Robotics, Large Language Models, Planning and Decision Making for Autonomous Robots, Dynamic Programming and Optimal Control, Control Systems*
Master's Thesis: *Learning Neural Vector Fields for Implicit Surfaces and Multi-view Reconstruction*
Semester Project: *Performance-driven Bayesian Optimization for MPC Tuning*

Universitat Politècnica de Catalunya — Barcelona, Spain
Bachelor in Telecommunications Engineering; GPA: 8.98/10, Ranked first of class — *September 2017 - June 2021*
Honours in 15 courses: *Fundamentals of Physics, Electromagnetism, Fundamentals of Computers, Object Oriented Programming, Vector Calculus, Electronic Functions and Systems, Systems Based on Microprocessors Design, Electromagnetic Waves, Mathematics for Telecommunications, Network Applications and Services, Introduction to Audiovisual Processing, Radiation and Propagation, Signal Processing for Communications and Audiovisual Systems, Signals and Systems, Audiovisual Technology and Production*
Bachelor's Thesis: *High-performance Model Predictive Control and Graph-based Simultaneous Localization and Mapping for an autonomous Formula Student race-car*

EXPERIENCE

Magic Leap — Zurich, Switzerland
Computer Vision Research Intern (Full-time) — *November 2023 - Ongoing*
- **Map-free localization in outdoor scenes.**: Research on vision-based localization solutions in map-free outdoor scenes.

Intelligent Control Systems Lab — Zurich, Switzerland
Research Assistant (Part-time) — *April 2023 - August 2023*
- **Performance-Driven Bayesian Optimization for MPC**: Research on goal-oriented safe Bayesian Optimization for MPC, with applications in autonomous racing. Developed a novel algorithm named COAT-MPC (Constrained Optimal AutoTuner for MPC). To submit to top-tier robotics conference in 2024.
    * Pre-print (progress): https://albertgassol1.github.io/papers/coat_mpc_pre_print.pdf.
    * Repo: https://github.com/albertgassol1/coat_mpc

Motional — Singapore
Semantic Map Research Intern (Full-time) — *September 2022 - March 2023*
- **Traffic light detection**: Sensor fusion between a camera and LIDAR accumulated point clouds for traffic light detection in C++ using Bazel. Deployed with Docker, AWS and Argo workflow.
- **LIDAR to camera targetless calibration**: LIDAR to camera targetless calibration using pole-like objects and semantic segmentation masks. Prototyped in Python using OpenCV, Open3D and PyTorch, and integrated in C++ using Bazel.

FULL-TIME PROJECTS

Image Communication and Understanding, Computer Vision Lab at ETH — Zurich, Switzerland
Master's Thesis (Full-time) — *April 2023 - October 2023*
- **Learning Neural Vector Fields for Implicit Surfaces and Multi-view Reconstruction**: Novel multi-view neural surface reconstruction method that models the scene geometry as unit vectors directed towards the nearest surface. State-of-the-art results in 3D reconstruction of indoor scenes. Submitted to a top-tier computer vision conference.
    * Pre-print: https://albertgassol1.github.io/papers/vf_nerf_pre_print.pdf

AMZ Racing — Zurich, Switzerland
Planning and Control Engineer (Full-time), Formula Student — *September 2021 - August 2022*
- **Performance-driven Bayesian Optimization for MPC tuning**: Semester Project at ETH. Safe Bayesian Optimization with a laptime performance constraint to automatically tune the MPC cost function weights. Implemented in Python using BoTorch, PyTorch, gpTorch, GPy, and ROS.
- **MPC for unknown tracks**: MPC for unknown tracks using a Pacejka dynamic bicycle model in spatial curvilinear coordinates. Curvature minimization to smooth the reference trajectory of MPC. C++ library using ForcesPro solvers, OSQP and ROS.
- **Lap time optimizer**: Lap time optimizer using a 4-wheel model of the car. C++ library using CppAd and IpOpt.

BCN eMotorsport — Barcelona, Spain
Autonomous Systems Lead (Full-time), Formula Student — *September 2020 - August 2021*
- **Lead of Perception, Estimation and Control**: Led a team of 10 engineers developing the autonomous system software stack of a driverless racing car from scratch. Season results:
  https://www.youtube.com/watch?v=ly_ax8w-T7E&t=1s

- $\circ$ **Graph-based SLAM**: Graph SLAM for online localization and race track mapping. C++ library using g2o and ROS.
- $\circ$ **MPC for unknown and known tracks**: MPC using a Pacejka dynamic bicycle model in cartesian and curvilinear coordinates. C++ library using a ForcesPro solver.
- $\circ$ **Modified Formula Student Simulator**: Introduced features in FSSIM to adapt the simulator to our autonomous systems stack. C++ library using Gazebo and ROS.

- **BCN eMotorsport** Barcelona, Spain
  Planning and Control Engineer (Full-time), Formula Student *September 2019 - August 2020*
  - $\circ$ **Track boundary estimation and trajectory planning**: Geometrical approach using Voronoi Diagrams to estimate the track boundaries from SLAM mapping data. C++ library using ROS.
  - $\circ$ **INS/GNSS sensor modeling for simulation**: Sensor modeling for the simulator. C++ library using Gazebo and ROS.

COURSE PROJECTS

- **Visual Odometry with a mono camera**: Accurate local pose estimation including Inertial Measurement Unit (IMU) measurements and Bundle Adjustment to tackle drift. Implemented in Python using OpenCV, NumPy and SciPy. Repo: https://github.com/albertgassol1/visual_odometry
- **Brand logo detection**: Trained a model to detect and classify logos from the Flick-27 dataset. Transfer learning with FasterRCNN and SSD. Repo: https://github.com/albertgassol1/logo-detector
- **Theoretical expressiveness analysis of LLM architectures**: Expressiveness analysis of current state-of-the-art language models such as Transformer architectures and RNNs. Prove their turing completeness and their expressiveness compared to classical Natural Language Processing models such as Pushdown Automaton.
- **Fine-tuning and security of modern LLMs**: Hands-on experience in fine-tuning T5 and Flan-T5 models using techniques such as LoRA, adapters and instruction-based fine-tuning. Red Teaming of GPT2 using hard and soft red lists.
- **Actor-Critic Reinforcement Learning**: RL to control the landing of a dual thrust spacecraft. Implemented in Python using PyTorch and Gym. Repo: https://github.com/albertgassol1/PAI
- **Bayesian Neural Network**: Number classification from images with uncertainty prediction. Implemented in Python using PyTorch.
- **Planning and Control of a spacecraft in a dynamic environment**: Obstacle avoidance, RRT* planner and tracking MPC. Implemented in Python using NumPy, Shapely, SciPy and do-mpc.

HONORS AND AWARDS

- **Ranked first of my Bachelor's class out of 300 students**.
- **Top average Bachelor's degree qualification**. Among the top 2% of all the students of my Bachelor's degree during the last 5 years.
- **Formula Student Germany 2022 Engineering Design Winners**. As a member of AMZ, I was part of the Design finals team, where we presented our autonomous system and we classified first among 66 teams.

SKILLS SUMMARY

- **Languages**: Catalan (Native), Spanish (Native), English (C1 Advanced and TOEFL 114/120)
- **Programming Languages**: Python, C++, C, Matlab, Bash, Java
- **Relevant Frameworks**: PyTorch, OpenCV, PyColmap, BoTorch, Open3D, PCL, Eigen, ROS
- **Relevant Developer Tools**: Git, Bazel, CMake, Docker, AWS, ArgoWorkflow