KHALID BOURR, Ph.D.

ROBOTICS & AUTONOMOUS SYSTEMS ENGINEER

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PROFESSIONAL PROFILE

Robotics PhD working across simulation, autonomous navigation, machine learning and hardware integration. Develops physics-based simulation tools and data-driven models, then connects planning and control software to real robotic and industrial systems. Experience spans ROS/ROS 2, Gazebo, terrain-aware navigation, embedded control, industrial drives and multi-robot systems.

CORE EXPERTISE

- Robotics software & ROS 2 architecture
- Autonomous navigation & path planning
- Control systems & robot integration
- Simulation, digital twins & sim-to-real
- Machine-learning surrogate modelling
- Embedded systems & industrial automation

PROFESSIONAL EXPERIENCE

UNIVERSITY OF TRIESTE | **Postdoctoral Researcher** | *May 2024 – Present*

Trieste, Italy (Remote)

- Developed an open-source Gazebo terramechanics plugin to simulate wheel–soil interaction across clay, sand, loam and Mars regolith; generated more than 91 million synthetic training samples.
- Trained a two-regressor XGBoost surrogate using the simulation data, reducing closed-loop simulation CPU cost by 2.5× while maintaining $R^2 \geq 0.997$ and a median Wasserstein-1 distance of 0.044 m/s against the reference model across 388 operating-condition bins.
- Designed a closed-loop validation protocol that pairs samples by operating condition rather than timestamp; performed a signed-mean force cross-check (r = 0.88).
- Evaluated traversability over a 200 × 200 m Mars-crater digital elevation model: 2.2 million predictions across 221,780 terrain-graph edges. Demonstrated that min-max-slip planning can select traversable routes where shortest-path planning cannot.
- Implemented path tracking on the Ackermann-steered Archimede rover and developed multi-layer grid maps for elevation, slip, traversability and obstacles.
- Created Forest3D, an open-source toolchain for generating Gazebo environments from digital elevation models with procedural vegetation; presented it at the official Gazebo Community Meeting (January 2026).
- Contributed to Gazebo core: entity identification for raycasts in gz-physics (#879, merged) and gz-sim (#3336).
- Mentored PhD and Master's students on ROS 2 integration and deployment on the Archimede rover.

NEXANEON | **Co-founder | Industrial Automation & Drive Repair** | *August 2023 – Present*

Kénitra, Morocco

- Co-founded an industrial automation and drive-repair company serving manufacturers including AGC Automobile, Nokia, Rieker Maroc and Fruit of the Loom; manage projects from diagnostics and quotation through commissioning and support.
- Repair and commission VFDs and servo drives up to 200 kW, including Danfoss, ABB, Siemens and Allen-Bradley equipment.
- Designed an ESP32 retrofit controller for an industrial washing machine: Modbus RTU over RS-485 to a Danfoss FC 51 VFD; PT100 temperature sensing via MAX31865/SPI; conditioned pressostat input via AD620; relay control of pumps, heating and inlet valve; Nextion touchscreen HMI.
- Resolved an audit-flagged cleanroom air-shower issue at AGC by reconfiguring a Siemens LOGO! controller without changing hardware.
- Upgraded Hänel storage-control software on existing hardware and replaced discontinued components on a PFAFF P21SE machine.
- Built DiagnoCom, a Python/FastAPI Modbus diagnostic tool, and an internal stock, quotation and invoicing platform using Spring Boot and Vue.js.

UNIVERSITY OF CAMERINO | **PhD Researcher** | *December 2019 – October 2023*

Camerino, Italy

- Developed a formal coordination layer on top of ROS, replacing fragile topic-based communication with a locality-aware model for multi-robot interaction.
- Created B2XKlaim, an open-source BPMN-to-code generator that converts visual mission designs into executable multi-robot coordination programs.
- Validated the framework in drone-and-rover scenarios involving sample collection, contamination localization and coordinated exploration.
- Completed a six-month research secondment at GSSI (L'Aquila) with Prof. Patrizio Pelliccione on scalable architectural patterns for multi-robot systems.
- Worked with physical X500 quadrotor and differential-drive mobile robots for navigation and sensor integration; published seven peer-reviewed papers.

I-SITE CLERMONT (CAP 20-25) | **Research Intern** | *February – July 2019*

Clermont-Ferrand, France

- Developed formal models and optimal-control algorithms for differential-drive robots, covering obstacle avoidance, energy efficiency and nonlinear-system controllability.

EDUCATION

Ph.D., Computer Science & Mathematics | University of Camerino, Italy | 2020–2023

Thesis: Model-Driven Development of Multi-Robot Systems

M.Sc., Mathematics | Clermont Auvergne University, France | 2016–2018

Control theory, optimization, robotics and nonlinear dynamical systems

B.Sc., Mathematics & Applications | Ibn Tofail University, Kénitra, Morocco | 2013–2015

Functional analysis, Fourier analysis and topology

TECHNICAL SKILLS

Robotics & autonomy: ROS/ROS 2, Nav2, MoveIt, multi-robot systems, autonomous navigation, terrain-aware planning, path tracking, SLAM-based mapping

Simulation & modelling: Gazebo, MuJoCo, Isaac Sim, digital twins, sim-to-real, Bekker–Wong terramechanics, DEM/GeoTIFF environments, numerical methods

Machine learning & perception: XGBoost, PyTorch, TensorFlow, YOLO, 3D vision, LiDAR, depth cameras, IMU, RTK-GNSS

Embedded & industrial: ESP32, Raspberry Pi, NVIDIA Jetson, Arduino, Modbus RTU/RS-485, MQTT, DDS, VFDs, servo drives, HMI, sensors and signal conditioning

Programming & tools: C++, Python, Java, MATLAB, SQL, JavaScript, FastAPI, Spring Boot, Vue.js, Git, Docker, Linux, CI/CD

Methods: Optimal control, ODEs/PDEs, vehicle dynamics, DSL development, model-driven development, BPMN, process algebra

SELECTED PUBLICATIONS

ML-Based Surrogate Modelling of Wheel-Terrain Interaction for Traversability-Aware Path Planning — First author; under review, IEEE Transactions on Robotics (T-RO), 2026.

Forest Surveying with Robotics and AI: SLAM-Based Mapping, Terrain-Aware Navigation, and Tree Parameter Estimation — Co-author; Machines 14(1), 2026 — Editor's Choice.

Translating BPMN Models into X-KLAIM Programs for Developing Multi-Robot Missions — First author; Software Tools for Technology Transfer (STTT) 27(6), 2025.

SELECTED PROJECTS

gz_terramechanics: Open-source C++/Gazebo plugin for wheel–soil interaction simulation; generated the dataset used for surrogate modelling.

Forest3D: Open-source Python/Gazebo/Blender toolchain for generating realistic simulation environments from DEM data with procedural vegetation.

B2XKlaim: Open-source Java/BPMN generator for translating visual mission models into multi-robot coordination programs.

Scenova: Proprietary simulator-agnostic scene compiler for physics-accurate worlds from DEM/GeoTIFF and Blender assets, with synthetic labelled-data generation.

LANGUAGES

Arabic (native) | French (C2) | English (C1) | Italian (B2)