

Dr Ibrahim Hroob

Head of Autonomy · LiDAR-Inertial Odometry, SLAM & Robot Navigation

PROFILE

Robotics engineer and technical lead with a PhD in long-term LiDAR localization and 6+ years building autonomy for robots that work without reliable GPS. Designed and built a production LiDAR-inertial odometry system from scratch (GTSAM factor graph, C++17), and leads the ROS 2 navigation stack it runs in, deployed across three robot platforms in agricultural field trials. Five first-author papers (IEEE RA-L, Robotics and Autonomous Systems, ECMR, IAS, TAROS). Current work at JABAS.AI takes GPS-free navigation from research into on-farm trials with commercial growers.

7.9 cm LIO RMSE over 4,800 field scans, 3× real-time	8 production ROS 2 packages authored or led	3 robot platforms on one stack, real and sim	160+ citations · h-index 7 · 5 first-author papers
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EXPERIENCE

Head of Autonomy · JABAS.AI (University of Lincoln / Ceres Agri-Tech spin-out), Lincoln 2025 – Present

Technical lead for localization and navigation for a GPS-free autonomy-as-a-service platform for agricultural robot fleets.

- **Built `jabas_lio` from scratch**, a tightly coupled LiDAR-inertial odometry system: GTSAM fixed-lag smoother (iSAM2), IMU preintegration with bias feedback, per-point deskewing, voxel map with incremental normals, and point-to-plane matching. Reached **7.9 cm RMSE over 4,800 field scans**, **8.3 mm stationary error**, and **30–65 ms per frame** against a 100 ms budget.
- Designed **custom GTSAM factors** for wheel-odometry and command-velocity priors. Their weights adapt to LiDAR observability, which keeps odometry stable in degenerate crop-row and tunnel geometry. Profile tuning **cut CPU 21%** for +5 mm RMSE.
- Wrote `nav2_costmap_row_controller`, a Nav2 plugin for Ackermann in-row driving. It detects boundaries from the costmap or point cloud, infers corridor width on its own, and keeps exact path distance even when localization degrades. Validated over 18 runs and 6,338 control cycles in a deterministic harness, with CI.
- Backported Nav2's latest **MPPI controller** and added a **four-wheel-steering motion model** with tests. Built a web "Control Room" for live telemetry and on-robot critic tuning.
- Architected `navstack_bringup`: one codebase covering GNSS/EKF fusion, LIO, point-cloud preprocessing, Nav2, topological navigation and safety guards. It runs on **AgileX Hunter**, **Dynium Gophar** and **Dogtooth**, real and simulated, with Docker devcontainers.
- Wrote `autonomy_metrics_logger`, which tracks autonomous distance, interventions and MDBI in MongoDB. It is the billing source of truth and survives database outages. Also wrote a **Livox Mid-360 Gazebo Harmonic plugin** and composable point-cloud filters (Patchwork++).
- Core contributor to `LCAS topological_navigation` (open source): ROS 2 port, route-segment metric maps, occupancy-grid publishing, and parameter-setting edge actions.

Robotics Software Engineer · University of Lincoln (Lincoln Centre for Autonomous Systems) May 2024 – 2025

- Designed a navigation-agnostic ROS 2 autonomy stack with stable interfaces, so planners and controllers can be swapped without changing upstream applications.
- Built a Kalman-filter pole tracker that holds landmark tracks through occlusion. Its output gives polytunnel row boundaries for in-row planning and stabilises localization without GPS.
- Set up systematic log- and replay-based validation for mapping and localization, and fixed drift, TF and integration faults on physical robots.

Research Assistant, Robot Autonomy · University of Lincoln Jul 2023 – Dec 2023

- Brought robots up on ROS 2: `ros2_control`, URDF, sensor and actuator drivers, and simulation parity packages.

Embedded Systems Engineer · Dicam Technology, Halesworth Sep 2019 – Sep 2021

- Real-time firmware and Modbus monitoring and control networks for farm automation. Wrote UART, I²C and SPI drivers, Bluetooth, and remote firmware update.

RESEARCH: FIRST-AUTHOR PUBLICATIONS

- [I. Hroob](#), B. Mersch, C. Stachniss, M. Hanheide. **Generalizable Stable Points Segmentation for 3D LiDAR Scan-to-Map Long-Term Localization**. *IEEE Robotics and Automation Letters*, 9(4), 2024. With the University of Bonn. [Code](#)
- [I. Hroob](#), S. Molina, R. Polvara, G. Cielniak, M. Hanheide. **Adaptive Robot Localization in Dynamic Environments through Self-Learnt Long-Term 3D Stable Points Segmentation**. *Robotics and Autonomous Systems*, 181, 2024.
- [I. Hroob](#) et al. **Learned Long-Term Stability Scan Filtering for Robust Robot Localisation in Continuously Changing Environments**. *ECMR*, 2023. [Code](#)
- [I. Hroob](#) et al. **LTS-NET: End-to-End Unsupervised Learning of Long-Term 3D Stable Objects**. *Intelligent Autonomous Systems (IAS-18)*, 2023.
- [I. Hroob](#) et al. **Benchmark of Visual and 3D LiDAR SLAM Systems in Simulation Environment for Vineyards**. *TAROS*, 2021. (39 citations)

Selected co-authored: Resilient TEB Planner (*J. Field Robotics* 2025) · Navigating Narrow Spaces for Agricultural Robots (*IEEE RA-L* 2025) · BLT Agricultural Multimodal Data Set (*J. Field Robotics* 2023) · Robotic Grape Inspection and Harvesting (*IEEE RAM* 2024).

TECHNICAL SKILLS

Estimation & SLAM	LiDAR-inertial odometry, factor graphs (GTSAM, iSAM2), IMU preintegration, ICP/point-to-plane, Kalman filtering, GNSS/EKF fusion, scan-to-map localization, observability analysis
Navigation	Nav2 (controller and costmap plugins), MPPI, topological planning, behaviour trees, Ackermann and four-wheel-steering kinematics
Perception & ML	3D point clouds (PCL), ground segmentation (Patchwork++), self-supervised point-cloud learning (PyTorch)
Software	Modern C++ (14/17), Python, ROS 2 (Humble/Jazzy), DDS, lifecycle and composable nodes, CMake/colcon, gtest/pytest
Infrastructure	Docker and devcontainers, GitHub Actions CI, Gazebo Sim plugins, rosbag replay benchmarking, MongoDB, Linux
Hardware	Livox Mid-360 and 3D LiDARs, IMUs, RTK GNSS, CAN, Modbus, microcontroller firmware

EDUCATION

PhD, Computer Science (Mobile Robotics) · University of Lincoln	Nov 2020 – Mar 2024
<i>Learning-based long-term localization in dynamic environments. EU H2020 BACCHUS project.</i>	
MSc, Embedded Systems (Distinction) · University of Essex	2016 – 2017
BEng, Mechatronics (First-Class Honours) · Palestine Polytechnic University	2009 – 2014