ARGUS

Autonomous Radiation-Guided Unified SLAM

A self-driving mobile robot that maps an unknown indoor space and the radiation field within it • Navya Sharma

On confidentiality. This work was carried out on placement at a national research facility. Owing to the sensitivity of the environment, this document stays at the level of engineering ideas: the facility, the instruments, the specific methods, the configuration, and the measured data are deliberately withheld. *This is a summary of an approach — not a manual, and not a data release. There is a great deal I cannot show here.*

The problem. Some interiors shouldn't be surveyed by a person walking through with a meter — because the layout is unknown, or because you would rather no one stood in the room while it was measured. ARGUS does the walk instead: it drives itself around an unfamiliar space, builds a map as it goes, measures the radiation field at every point it passes, records those readings onto the map, and **refuses to cross ground it has measured as contaminated, or has not measured at all.**

That final clause is the crux. A robot that maps a hazard but drives through it anyway has not understood the hazard. Making the measurement genuinely constrain the motion is where the engineering lives.

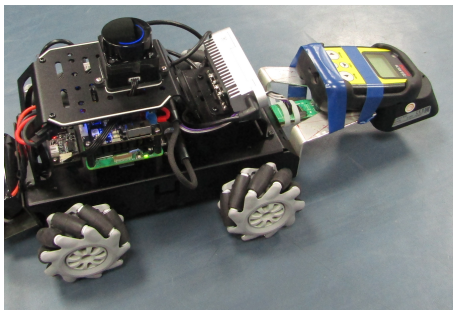

Figure 1: The assembled mecanum-wheeled platform.

How it fits together

Four ideas stacked on one another — each working only because the one beneath it does:

1. **Knowing where it is.** Wheel odometry gives a smooth but drifting position estimate; LiDAR SLAM pins that drift to a consistent map. Together they give every reading a real place in the world.
2. **Reading the field correctly.** A live sensor stream is decoded into correctly scaled physical values and kept alive across long runs. It was validated against an independent reference — internal consistency alone proves nothing, since a uniformly mis-scaled decoder agrees with itself.
3. **Placing the reading precisely.** A value belongs where the *detector* was, not where the robot's centre was; correcting that fixed offset keeps the map sharp.
4. **Letting the map steer.** The planner treats a measured hot region as an obstacle and unmeasured ground as off-limits, while frontier exploration drives the robot to complete the survey on its own.

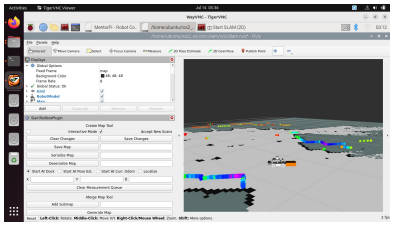

Figure 2: 2D occupancy map built live.

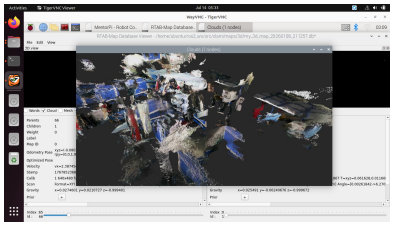

Figure 3: Dense 3D reconstruction.

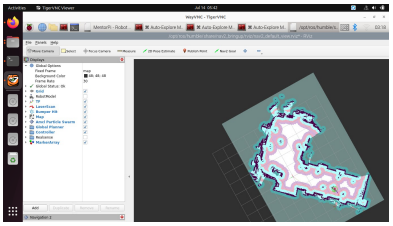

Figure 4: Autonomous frontier exploration.

The lesson worth keeping. In a layered system a fault never appears where it lives. Odometry that lies quietly at the bottom of the stack presents, several layers up, as a *radiation-mapping* bug — and is easily debugged for a long time in the wrong subsystem. So the system was validated strictly bottom-up: no layer was trusted until the layer below it had passed a concrete, falsifiable test. That discipline was the real deliverable.

Honest limits

The autonomous, radiation-aware behaviour was demonstrated on the physical robot. The full internal writeup is careful to separate what was *delivered* from what was *demonstrated during development* — they were not identical, and saying so is the right kind of confidence. The interesting part of any engineering story is usually in the caveats, not the headline.

Detailed engineering, operations, and handover documentation is held confidentially and is not published.
Happy to discuss the approach in general terms.