A Set of Holistic Modifications to the BlueBoat Platform Supporting Research and Education

From Knowledge to Competitiveness

Portugal-US Partnerships 2026 Summit

MIT Portugal Program

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Objective — a fleet-scale platform from a $5k USV

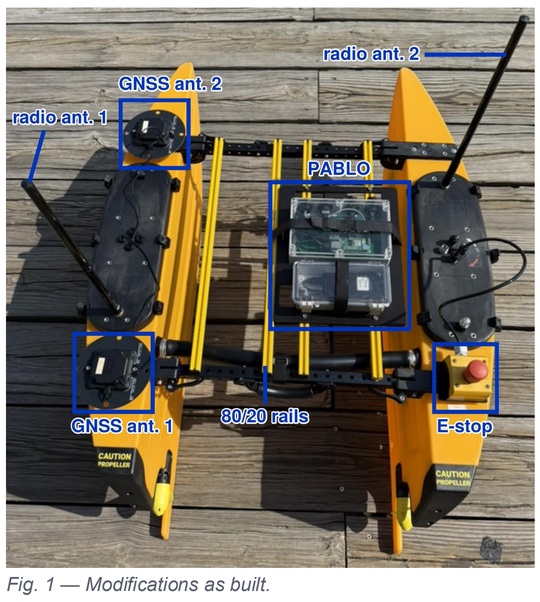

Fig. 1 — Modifications as built.

- Fleet + classroom use demands fail-to-stop safety, standard payload interfaces, comms beyond one shore link, ground-truth navigation, and software layers students can modify safely.
- **80/20 rails:** standard mounts, 15 kg payload.
- **PABLO:** RPi 4/5 or Jetson Orin back-seat computer, hot-swappable in seconds.
- **Mesh radio:** Doodle Labs dual-band; link telemetry published into MOOS as a sensor.
- **RTK GNSS:** UM982 dual-antenna, cm-level fix, 10 Hz heading at zero speed.
- **Payloads to date:** side-scan, forward-looking and scanning sonars, DVLs, cameras, echosounders — swapped in minutes without tools.
- **Safety layers:** hardware E-stop → RC deadman → teleop deadman → launch gates → EKF halt on GNSS loss; thrust arbitration RC > teleop > autonomy.

Methods — autonomy stack and networking

- Front seat (RPi, always running) owns hardware and control; back seat (PABLO) runs the EKF, IvP Helm and missions. Backseat payload can be swapped without touching vehicle control (ROS-compatible).
- Every subnet derives from BOAT_ID; a portable shoreside (MikroTik + Wearable mesh + Starlink) moved the lab network to Greece with three values changed per boat.

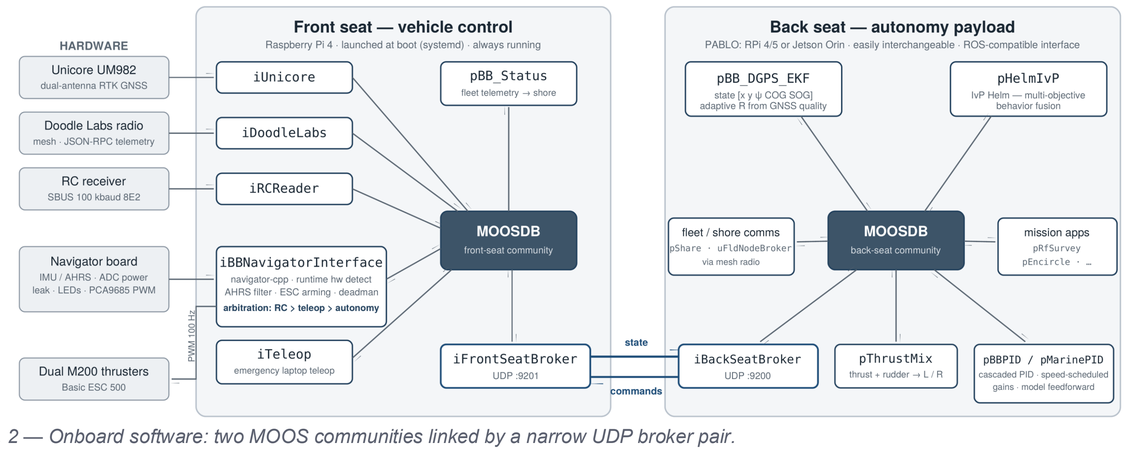

Fig. 2 — Onboard software: two MOOS communities linked by a narrow UDP broker pair.

Key result 1 — Six BlueBoats operated by 25 students for a week in Athens (MIT 2.680 mini-course, June 2026)

6	25	29.0 h	99.1 km	2.4 kWh
boats built in 3 days	students, 5 teams	in motion over 5 days	covered by the fleet	total fleet energy

Fig. 3 — The modified fleet underway during the Athens deployment (left); the operating area at the sailing club, with surveyed buoys (right).

- Lab sequence: COLREGS waypoint missions → multi-vehicle encircling with auction task allocation → a rescue competition with student-written search algorithms; seven single-elimination heats.
- 23 GB of front-seat logs; every figure reconstructed from onboard data. GNSS healthy throughout (23–26 satellites, HDOP ≈ 1.0); one vehicle lost to an electrical fault on day 2.

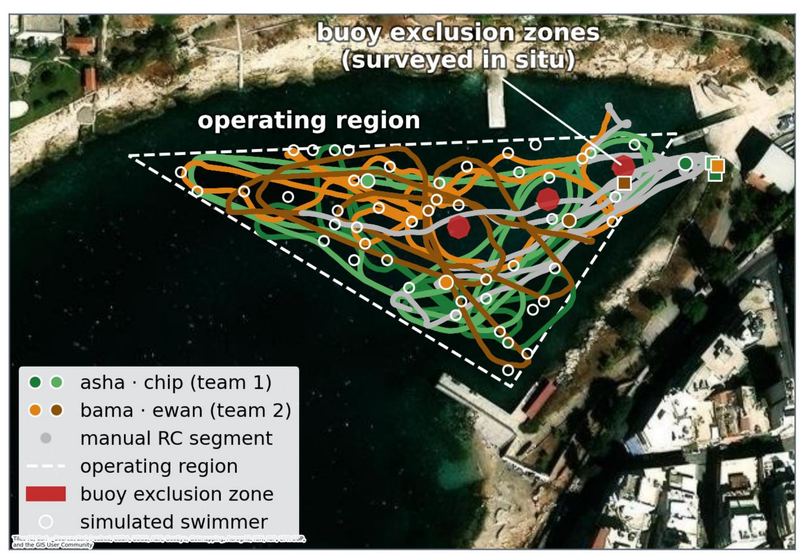

Fig. 4 — Championship rescue heat, 26 June: four student back seats run concurrently inside the shared region, avoiding buoy exclusion zones (red) surveyed in situ.

Key result 2 — Comms-aware autonomy and RTK ground truth at the MIT Sailing Pavilion

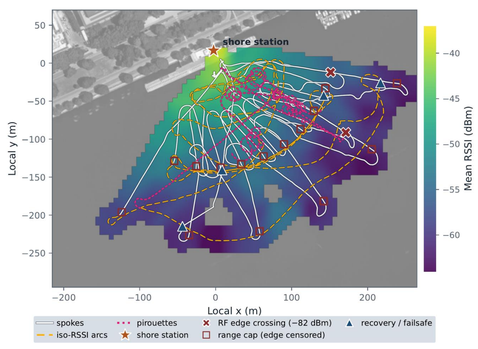

Fig. 6 — Adaptive RF survey (3 runs, 12,566 samples) over the measured RSSI field; all edge decisions made onboard. Log-distance fit n = 2.1 → ~1 km shore range.

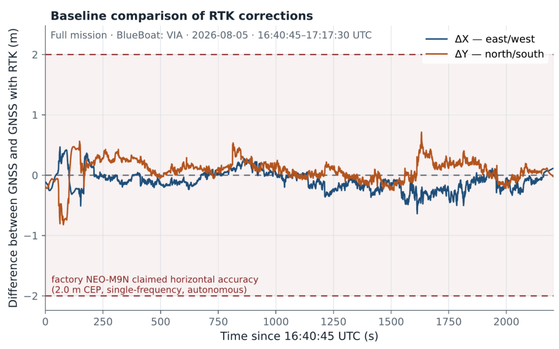

Fig. 7 — Code vs. RTK-fixed horizontal disparity, 37 min at 10 Hz: 1.2 cm vs. 41 cm 1σ, RTK fixed in 100 % of epochs. Uncorrected in Athens: 1.3–1.8 m.

Conclusions and future work

- A low-cost commercial USV extended into a fleet-scale platform for research and education: 25 students, six vehicles, 29 on-water hours and 99 km in one week.
- A vehicle mapped its own radio environment and maneuvered in closed loop on link telemetry; RTK held cm-level navigation where the factory receiver claims 2 m.
- Next: multi-vehicle mesh formation control and channel management; payload sensing on RTK ground truth; collaborative autonomy in heterogeneous fleets.

Read the full paper

J. Wenger et al., "A Set of Holistic Modifications to the BlueBoat Platform Supporting Research and Education," OCEANS 2026, Monterey, CA.

Scan for moos-ivp-blueboat code base.

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