Rapid-prototyping and field deployment of a USV for the Metropolitan Police

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Application

The Metropolitan Police, the main police force of the Greater London area, have a nationally deployable team of specialised divers capable of carrying out a variety of underwater missions. Researchers at the University of Bath are assisting the Metropolitan Police by developing autonomous robotic systems to aid and complement the capabilities of their divers. The aim is to develop an ultra-portable and fully autonomous robot equipped with sensors that can inspect the underwater environment for objects of interest (e.g. evidence, weapons, and improvised explosive devices) as well as potential hazards to the divers.

Requirements

- Target localisation with an accuracy of less than 1m
- Human-portable system, deployed by up to 2 people
- Display data in an intuitive form, suitable for an untrained operator
- Relay status updates in real time for remote monitoring
- Secure communications to a land-based control station and manual override

Use case 1: Deploy the platform in the 90 minute diver preparation window. The body of water is surveyed to aid the divers in planning the mission.

Use case 2: Divers are unable to work during the night. This presents an opportunity to extend search operations overnight, surveying large areas.

Rapid Prototyping

A series of unmanned surface vehicles (USVs) have been created via a “rapid prototyping” approach using a combination of laser-cutting, 3D printing, and off-the-shelf components. This has led to a highly modular design, which allows:

- Adaptation of the platform to suit a wide range of mission profiles
- Operation in shallow or deep water i.e. canals, rivers and lakes
- Operation as a catamaran or trimaran, depending on environment
- Dynamic reconfiguation of electronic payload

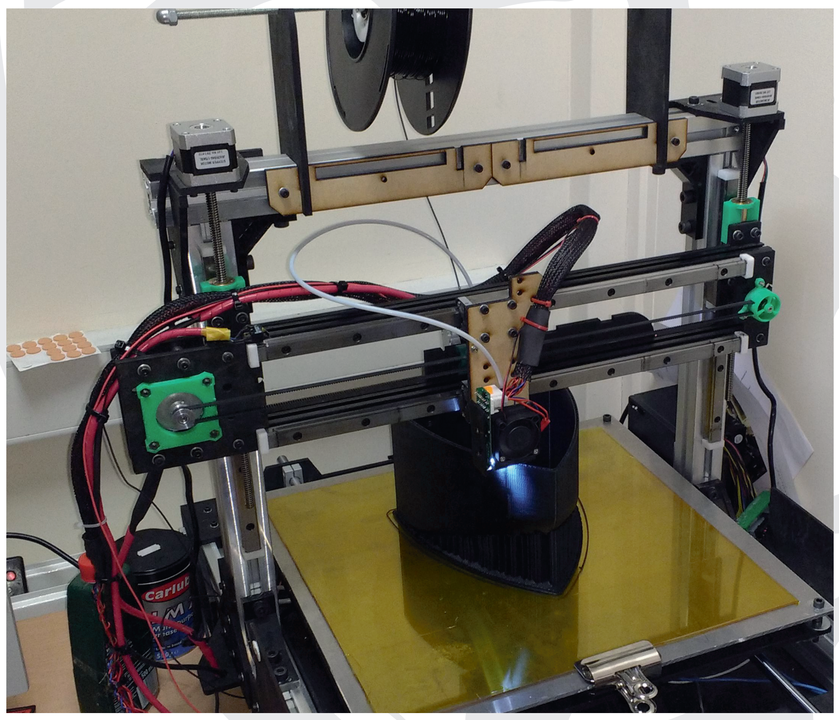

Figure 1: 3D printing a bow section with polylactic acid

Sensor Payloads

The platform is equipped with various sensors, including:

- GPS for localisation and georeferencing
- Magnetometer for bearing estimation
- Inertial measurement unit, for increased localisation accuracy
- Side-scan sonar, a 2D imaging sonar with a large coverage rate
- Multi-beam echo sounder, a high resolution 3D imaging sonar
- Top-side camera for obstacle avoidance and informing later path planning
- Underwater camera for interrogation of shallow targets

Information provided by these sensors enables autonomous path planning and navigation. This allows the system to be used with minimal human intervention.

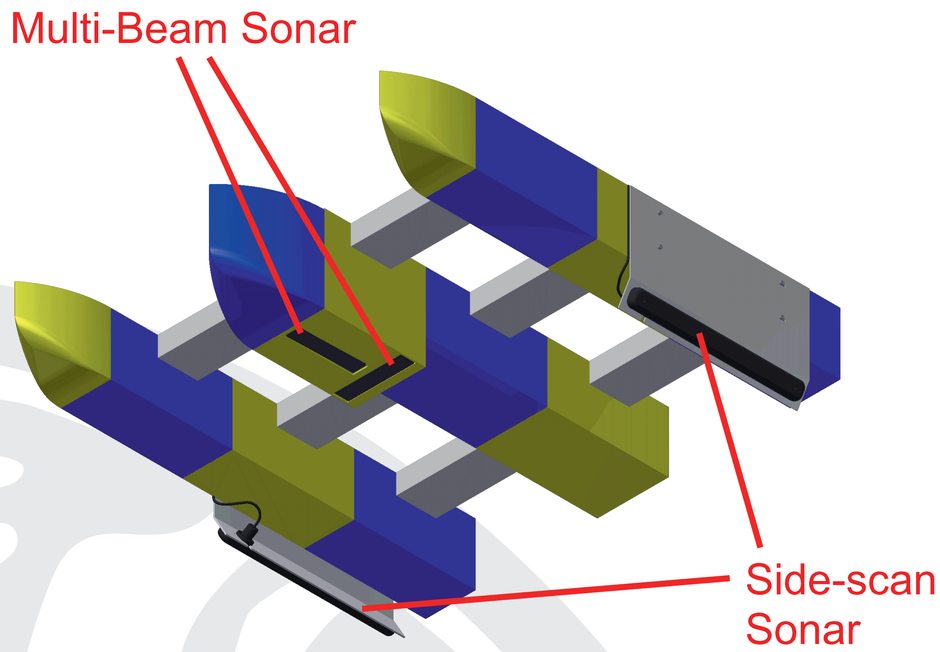

Figure 2: Render of USV in trimaran configuration

Field Deployment

Figure 3 shows the platform in catamaran form, performing a sidescan sonar survey. The system uses the navigation sensors to georeference the data collected from the environment. This allows it to be displayed in a simple, human-readable display, as shown in Figure 4.

The information gathered is used to interrogate specific areas of interest in greater detail and inform subsequent path planning.

Figure 3: Unmanned vehic in catamaran configuration, performing a sidescan sonar survey

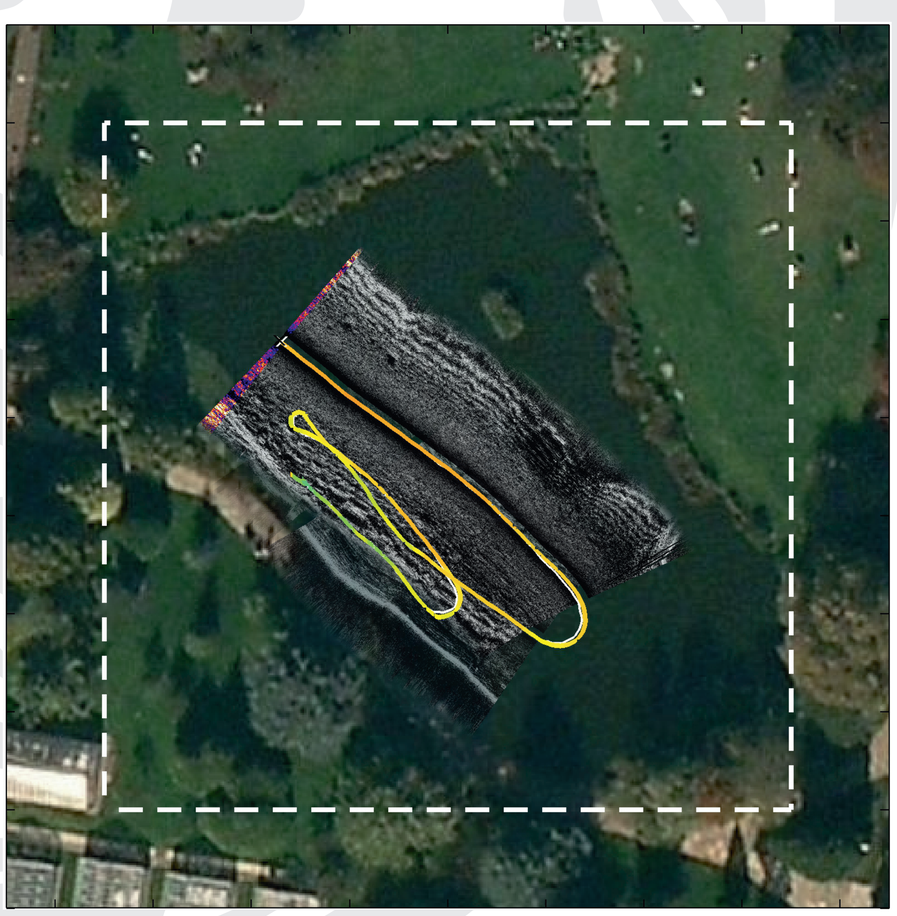

Figure 4: Sidescan Sonar map of the floor of the campus lake at Bath University, demonstrating georeferencing of sonar data

Future Work

Further work aims to develop an operational system to be used by the MET in the field, requiring the following developments:

- Continued development of platform and deployment system
- Automated interpretation of sonar data and object recognition
- Intelligent path planning and obstacle avoidance
- Effective data visualisation and human interfacing


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