Intelligent lines and curves following for shipwreck search with an autonomous robot

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Students: Around 4, could be a mix of HYD and ROB or just ROB
Hardware: Zodiac, kayak, magnetometer, sub-bottom profiler

For the search of the Cordelière wreck near Brest harbor, a standard rubber boat has been made autonomous and equipped with a towed magnetometer (under a towed kayak) and a sub-bottom profiler (see https://www.youtube.com/watch?v=4b2PZv-fIUI).

The magnetometer is used to detect unusual magnetic variations that could be due to iron parts of a wreck, and the sub-bottom profiler enables to detect acoustically any wreck parts that could be below the sea floor. There are several constraints for each sensor to work correctly:

- Since the magnetic perturbations can be very low and depend on the size, distance and materials of the wreck parts, the magnetometer would need to be stabilized at less than 5 m from the sea floor. However, we must also ensure that it does not touch anything on the sea floor. Additionally, since it is towed, the trajectory of the rubber boat needs to avoid sharp angles.
- From the first tests made in July, the sub-bottom profiler, that was directly mounted on the rubber boat, is perturbated by the rubber boat motor, so it would be necessary to stay at low speed or study other ways to limit these perturbations (e.g. isolate it from the rubber boat, etc.). For this reason, the magnetometer was the preferred sensor for the search of the wreck up to now.

Here is a list of possible tasks to improve the system designed for wreck search:

- Implement an intelligent lines and curves following algorithm inspired from https://www.ensta-bretagne.fr/jaulin/paper_slalom.pdf to follow a better area scanning pattern.
- Currents could be also taken into account to be as accurate as possible in the rubber boat control.

- Make a magnetic map of an area of Guerlédan lake (e.g. to try to find the wreck of a sunk Parrot Bebop drone). A method to guarantees that all the defined area should be scanned taking into account the sensors range, localization and control uncertainties should be developed for that purpose. The sub-bottom profiler could be also used to confirm the presence of the wreck or other objects as well as an aid to stabilize the magnetometer at a desired altitude. An altimeter could be also integrated to the magnetometer to help for that.
- Develop different methods of obstacle detection and avoidance, since the area to scan might have static obstacles such as buoys as well as other boats.

Some unit tests could be also made on the Panopée or other smaller robots to test or validate specific points more easily.

More information is available on the following links:
- https://www.ensta-bretagne.fr/jaulin/boatbot.html
- https://github.com/EnstaBretagneClubRobo/ZodiacAuto .