AS-84.3146 Behavior-Based Robotics

29.10.2007

(You can answer either in Finnish or English / Voit vastata suomeksi tai englanniksi)

1. Service Robotics

Home robotics: current status and future trends

2. Control Architectures

Explain the main features of reactive, deliberative (planning based) and hybrid control approaches

3. Control Architectures

AuRa architecture: the structure and main principles

4. Multi-robot systems

Why to use multi-robot systems?

5. Finite State Automata(FSA)

Create a FSA for a single underwater robot (SWARM)

Once the power has been switched on and the robot has been put into water, it performs an *initialization* procedure. After successful initialization (INIT=TRUE) it tries to *localize* itself with a GPS, and after the GPS fix (GPS=TRUE) it contacts the operator via satellite *communication*. If the operator has some messages to the robot (MSG_TO_ROB=TRUE), it then *modifies* its operation and then starts the actual mission, which will last for 10 days (TIMER_MISSION=10days)

By using its pressure sensor P, the robot *dives* from the surface (P_surface) to a certain depth (P_mission) with the certain accuracy (P_delta). It stays in that particular depth for 24 hrs (TIMER_MEASUREMENT=24hrs) and during that time it *performs measurements*. After 24 hrs it *surfaces* and transmits the gathered information to the operator (sat. comm.) and listen if the operator has some messages to it. If there is an incoming message, it will then implement the possible changes. The message from the operator can include a mission abort command. If the robot has received that command (ABORT=TRUE) it moves to wait_for_pick_up mode. It stays on the surface and gets the position fix every hour (TIMER_PICKUP=1hr) and sends the localization info to the operator immediately after that. It does that until the operator comes and picks it up (P_air). If no abort command has been sent the robot continues its mission and dives back to the mission depth and stays there for another 24 hrs measuring the environmental parameters. And then it comes again to the surface and communicates. And so on and so forth, until the abort command has been received or the mission time is full (after that the robot acts similary as after the abort command).

In addition to the normal mission operations, the robot has to *avoid colliding with the seabed* (bottom) during the diving phase. The approaching seabed can be detected with a down-looking sonar. The value of the sonar should always be greater than 5 meters. If the value is smaller than that the robot should abort the diving and come upwards so that the distance to the bottom is at least 5 meters

The problems related to the actual software or hardware should be handled in a separate procedure which will be activated if ERROR_FLAGS should become true.

The sensors

- External_sensor: GPS
- External_sensor: S (down-looking sonar)
- External_sensor: SATCOM (satellite communication)
- External_sensor: P (pressure sensor)

- internal_sensor: TIMER_MISSION
- internal_sensor: TIMER_PICKUP
- internal_sensor: TIMER_MEASUREMENT
- internal_sensor: ERROR_FLAGS

Based on the above task and sensor descriptions, draw a FSA for the case.
On the next page you will see a general graphical representation of the mission.

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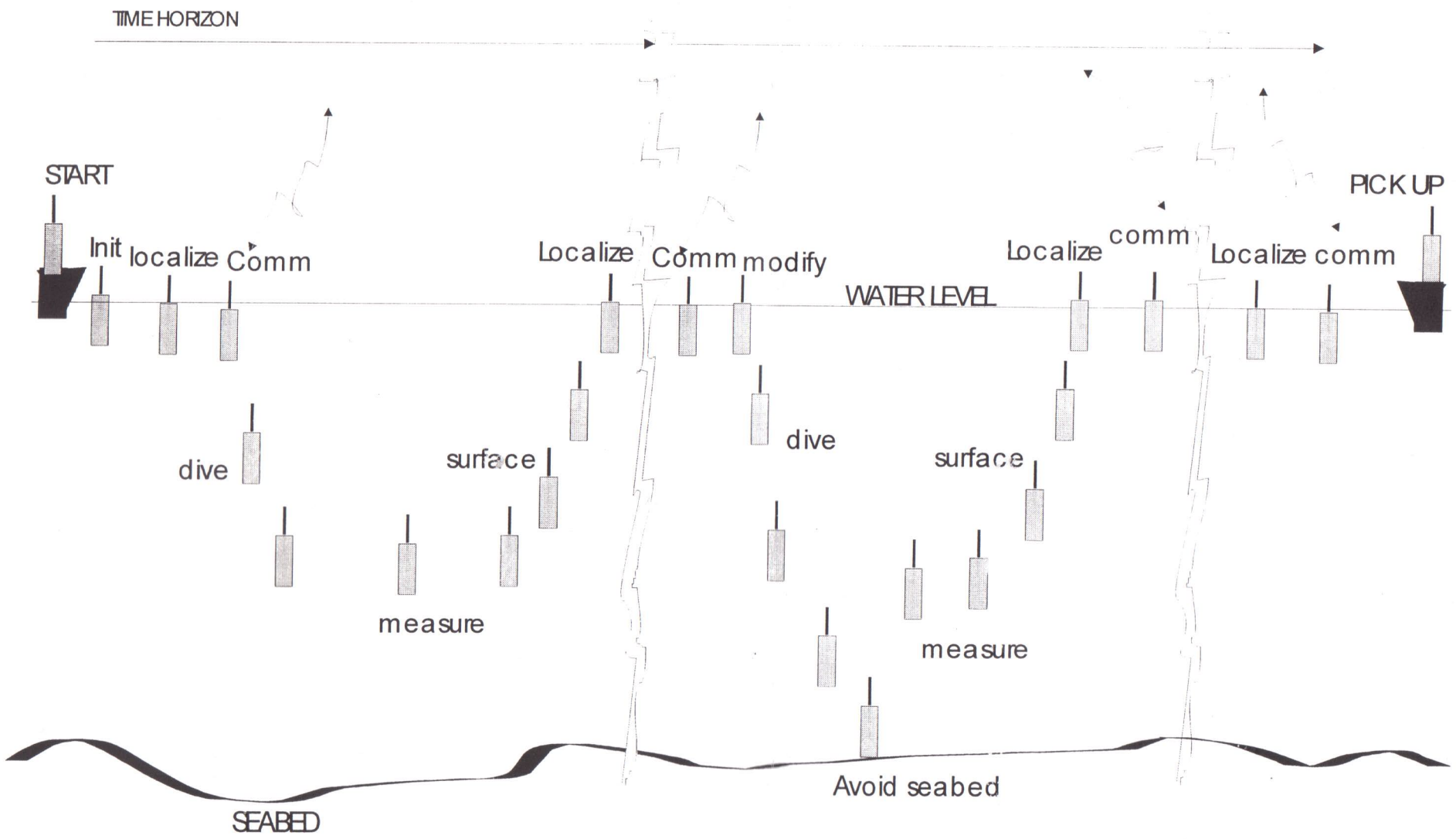
TIME HORIZON
START
Init
localize
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modify
WATER LEVEL
Localize
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Localize
comm
PICK UP
dive
surface
measure
dive
surface
measure
Avoid seabed
SEABED