German Research Center for Artificial Intelligence GmbH

CUSLAM

Confined Underwater Simultaneous Localization and Mapping

Dagon during a mission at the artificial reef near Rostock

Under-Ice exploration in the university lake in Bremen

The AUV „AVALON“ just before a mission

Localization and mapping in confined underwater environments

The aim of the CUSLAM project is the development of an algorithm which allows localization and mapping in complex, spatially confined underwater environments. This algorithm is supposed to allow deployment of autonomous underwater vehicles (AUVs) in complex underwater environments, such as underwater production/processing plants, in a safe and reliable manner. The aspects safety and robustness play a key role: only when both aspects can be fulfilled, the use of AUVs for supervision and exploration tasks becomes economically feasible. The high degree of difficulty results from the combination of a number of already hard single tasks:

- Underwater navigation, localization and mapping
- Navigation in confined, dynamic 3d-spaces
- Complex task completion by weakly supervised autonomous systems

The CUSLAM-algorithm approaches the demands of each individual task in such a way that the final algorithm will master the complete task: the robust, autonomous localization and mapping in spatially confined underwater environments.
In order to prove the reliability, validity and robustness of the developed algorithm extensive experiments will be conducted. The complexity of these experiments will be increased incrementally: in the beginning only singular tasks will be fulfilled in laboratory environments, but in the end the complete task will be mastered under realistic conditions at the artificial reef of the University of Rostock.

All experiments will be conducted using the AUV “AVALON”, developed by the DFKI. This AUV will be equipped with a number of special high-resolution measurement devices, which allow a validation of the CUSLAM-algorithms results. In order to achieve this, the measurements of these new sensors will not be given to the algorithm; they will only be used for validation purposes. This results in an algorithm which does not rely on specialized measurement equipment, and thus makes adaptation to small, weakly instrumented but economically feasible AUVs possible. The robust localization and mapping inside an underwater production/processing plant is meant as benchmark for the algorithm’s performance. The artificial reef of the University of Rostock in the Baltic Sea will serve as approximation to this scenario. Since this task can be considered significantly more complex than localization and mapping over free terrain, the algorithm will automatically be able to handle this scenario as well.

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