A Path Planning Algorithm for an AUV Guided with Homotopy Classes

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Abstract
We propose a method that uses topological information to guide path planning in any 2D workspace. Our method builds a topological environment based on the workspace to compute homotopy classes, which topologically describe how paths go through the obstacles in the workspace. Then, the homotopy classes are sorted according to an heuristic estimation of their lower bound. Only those with smaller lower bound are used to guide a planner based on the Rapidly-exploring Random Tree (RRT), called Homotopic RRT (HRRT), to compute the path in the workspace. Simulated and real results with an Autonomous Underwater Vehicle (AUV) are presented showing the feasibility of the proposal. Comparison with well-known path planning algorithms has also been included.

1 Introduction
• Guide topologically a path planning algorithm using homotopy classes

2 Generation of the Homotopy Classes
• Construction of a topological environment to compute homotopy classes that can be followed in any 2D workspace

3 Homotopic RRT (HRRT)
• Constrained growing of the tree into those directions that satisfy the homotopy class

4 Results
Simulated Results
1000x1000 scenario with 15 obstacles

Experimental results
Test with the SPARUS AUV in a water tank

5 Conclusions
• We propose a method to generate homotopy classes that can be followed in any 2D workspace
• The homotopy classes are sorted according to a lower bound estimator
• The HRRT computes paths in the workspace following the homotopy classes previously found
• The method has been tested in simulation and with an AUV in a controlled unknown environment

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