Genetic Planner for a Mobile Robot Navigation System

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The mobile robot (*mobot*) problem is as follows: given a description of a known environment, plan a path from a start to goal position which avoids collision and satisfies other user specified constraints [3]. Characteristics of the navigation problem is that it is PSPACE-hard, and in general the computational cost of path planning increases exponentially [2]. We present an overview of an off-line deliberative navigation layer based on a genetic algorithm (GA), our long term objective being the design and implementation of a four layered robot pursuit-evasion architecture.

GAs have proved to be very effective in search and optimization problems which are not amenable to traditional methods. Currently, for GA navigation, the environment must be known a priori and thus be static. The GA has an augmented set of operators specific to the problem domain. These operators are selected using an adaptive scheme which adjusts the operator probability according to its effectiveness in evolving better solutions. Fitness is determined on criteria such as number of intersections, length, smoothness, etc.

Six test environments were used to empirically evaluate the performance of GA navigation, with sample paths for two test domains depicted fig. 1. Once the GA has completed it's run, the best path generated is then ported and tested on a Pioneer robot simulator. Several problems had to be addressed including position encoding and self localization errors. Testing consisted of two phases: a) evolving the paths using the GA b) encoding the best solution path as a fuzzy behaviour to be run on the robot simulator.

The results demonstrate that the application of GAs to navigation is a research avenue with considerable potential. However, several issues have to be addressed, such as stopping criteria and the development of more computationally robust models of operator adaptability. Current research is focused on reducing the off-line constraints on the GA layer to enable navigation in dynamic environments characterized by low rates of change. This will involve the integration of both a reactive online subsumption layer with the deliberate GA one, in which polygenic inheritance is used as the representation scheme.

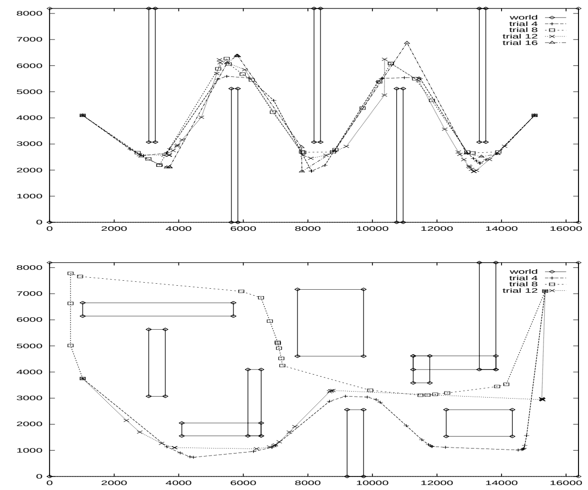

Figure 1: Sample paths evolved by the off-line GA navigation module for test environment 3 and 6.

References

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