TOWARDS COSMOPOLITAN ROBOTS: INTELLIGENT NAVIGATION IN EXTENDED MAN-MADE ENVIRONMENTS

A Dissertation Presented

By

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ABSTRACT

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In the past, mobile robots have been constrained to operate in either an indoor or an outdoor environment, not both. Special purpose representations and ad hoc sensor techniques geared towards tasks of narrow focus have dominated these efforts. It is the purpose of this dissertation to lead towards the development of a more cosmopolitan robot; one whose domain of interaction is not as restricted as these previous attempts.

The Autonomous Robot Architecture (AuRA) has been developed to meet these challenges. A "meadow" map, used for global path planning and containing embedded *a priori* knowledge to guide sensor expectations, serves as the robot's long term memory. A layered short term memory based on instantiated meadows represents the currently perceived world. A hierarchical path planner produces a global path free of collisions with all modeled obstacles.

Schema theory is extended to include the mobile robot domain and serves as the principal theoretical framework. The schema-based path execution system handles unexpected and dynamic obstacles not present in the robot's world model. This motor schema-based navigation system produces reactive/reflexive behavior in direct response to sensor events. In addition, new techniques in the treatment of robot uncertainty which expedite sensory processing are presented. These include the use of a spatial error map with associated error growth and reduction techniques.

Several computer vision sensor strategies have been developed for use within AuRA. These include a fast line-finding algorithm, a fast region segmentation algorithm, and a depth-from-motion algorithm. Experiments using our mobile vehicle HARV demonstrate the use of these vision algorithms for navigational purposes. Schema-based navigation using ultrasonic sensing is also demonstrated experimentally.

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