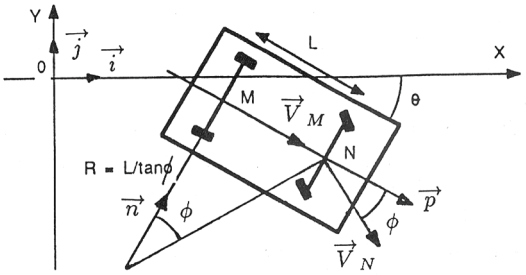
MSSE Measurement Science and Systems Engineering Division

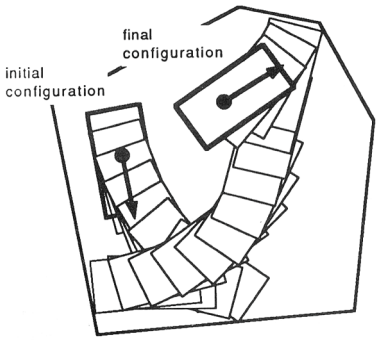
ROBOTICS AND ENERGETIC SYSTEMS RESG GROUP

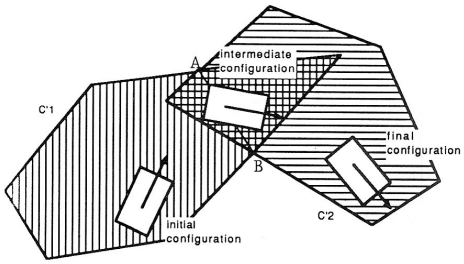
Motion Planning for Non-Holonomic Wheeled Vehicles

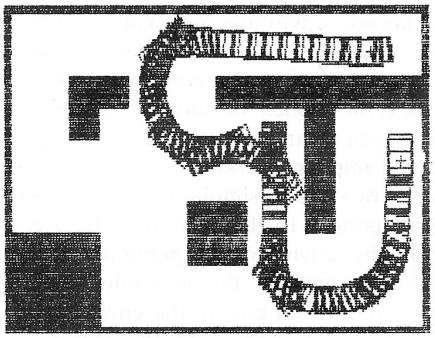
Motion planning for car-like robots can be extremely computationally extensive because of the non-holonomic constraint that affects their kinematics. This non-integrable constraint restricts the space of achievable velocities but does not affect the space of achievable configurations. In other words, a car can reach any position and orientation in free space, however may require maneuvers to do so because it cannot move sideways (its velocity direction is constrained).



We have developed several computationally efficient algorithms for the motion planning of wheeled robots affected by a non-holonomic constraint in environments with obstacles. The algorithms apply to environments that are either known a priori or that are progressively discovered using range sensors. The algorithms first decompose the known portion of the environment in convex cells, and determine a cell sequence that brings the robot near its goal. Adjacent cells are augmented to overlap each other, providing a transition area from cell to cell during the progression. Collision-free trajectories within each of the cells, including necessary maneuvers, are then calculated in a computationally efficient manner using the convexity properties of the cells. The result is a continuous collision-free path to the goal respecting the non-holonomic constraint of the vehicle. In the case of a priori unknown environments, the same algorithm is used to build the path progressively as the robot moves to, and thereby can sense, new areas.







Point of Contact:
Dr. François Pin (865-574-6130, pinfg@ornl.gov)
Oak Ridge National Laboratory, P.O. Box 2008,
Oak Ridge, TN 37831-6305