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“Navigation and Obstacle Avoidance of Autonomous Mobile Robots in an Unstructured Environment” –  

Abstract  
In this study various trajectory tracking and posture stabilization controllers for differentially driven wheeled mobile robots are studied, simulated and their effectiveness compared. Also, various Path Planning and obstacle avoidance techniques are evaluated.  

In robotics research, trajectory tracking and obstacle avoidance are typically considered as separate problems. The main contribution of this study is that of amalgamating these two situations so as to have a mobile robot working in an unstructured environment capable of tracking a desired trajectory and at the same time avoiding obstacles along the path basing solely on local sensing information. After avoiding an obstacle, it must be guaranteed that the robot catches up with its target trajectory and the error between the actual and desired robot position on the trajectory asymptotically converges to zero in minimal time.  

One solution to the above consists in using a nonlinear trajectory tracking controller together with a Modified Artificial Potential Function [1]. A switching mechanism is used to changeover between trajectory tracking and obstacle avoidance to ensure that when no obstacles are present, the robot is guaranteed to converge to its target trajectory with zero steady state error.  

Artificial Potential Functions have the well known undesirable problem of local minima. To avoid this, a new method for obstacle avoidance within trajectory tracking is proposed by using the Limit Cycle Navigation method [2]. This navigation method creates a trajectory around the obstacle rather than a repulsive force. In addition, modifications to the navigation scheme are proposed so as to handle local sensing of obstacles.  

This study also goes into the hardware and software design of a differentially driven mobile robot fitted with ultrasonic range finding for obstacle detection. This robot is used to obtain experimental results on the control systems studied.  
