Abstract

Mostafa Ali Ibrahim Salama

Kinematic Design of Omnidirectional Mecanum Wheeled Mobile Robot

One of the main concerns about wheeled mobile robots is the presence of singular points within their workspaces. In singular positions the robot loses one or several degrees of freedom. This means that the robot cannot move along (or around) some directions. It is difficult to control the robot mechanism in singular position. The avoidance of these singular positions has to be taken into consideration when selecting the design parameters. A prerequisite to this is through knowledge about the effect of design parameters and constraints on singularity. In this study, quality condition index was introduced as a criterion for evaluating singularities of different configurations of a mecanum wheeled mobile robot obtainable by different design parameters. It was illustrated that this method can effectively be employed to obtain the optimum configuration of mecanum wheeled mobile robot with the aim of avoiding singularity within the workspace. This method was then employed to design the wheeled mobile robot with different arrangements of mecanum wheels. Chapter one includes an introduction which shows what is robotics and the disadvantages that robotics faced like lack of mobility. In addition, an introduction to what is omni-directional mobile robot, types of omni-directional wheeled platforms, some special a wheel design, specially the mecanum wheel, and shows the basic motions for an omni-directional mobile robot with four mecanum wheels. In chapter two, includes a background about some of the different design ideas currently being investigated around the world, and literature review which includes some previous works. Chapter three shows the kinematic design of wheeled mobile robot with mecanum wheels, kinematic modeling for ? wheeled platform, and introduces the index of performance. Chapter four presents the results and discussions for different cases with different configurations, different arrangements, and different design parameters. ABSTRACT II Chapter five shows the conclusions for the present work as follows, 1. It is apparent that the condition number based on Frobenius norm is smooth everywhere. 2. The value of the roller angle affects the value of the condition number (Index of performance). 3. At condition number = 1: the value of the basic dimension and the corresponding aspect ratio depends on the maximum translational and rotational velocities of the platform (Characteristic Length). 4. (Car like robot) is preferred than any four wheel arrangement. 5. The choice of three wheel configuration is always for small basic dimension (small applications). At the end of the present work some recommendations which may be added to the present work are presented.