The Study of Control for Nonholonomic Systems -- Space Robots and Mobile Robots

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ABSTRACT

ABSTRACT Nonholonomic mechanical systems are systems with nonholonomic constraints. These constraints restrict the system motion in a subspace of the velocity space. In mathematics, the constraints have the nonintegrable property, that is, they can not be exactly integrated into the closed form. Therefore, we are not able to convert them into the geometric restriction in the configuration space. The well known result about nonholonomic system is that the change of the system''s position or orientation depends only on its motion path but not on the moving velocity along the path. In this thesis, we will study two kinds of nonholonomic systems. The first one is a space robot system. The main purpose of this system is how to control its absolute orientation with the motion of joints of robot arms. We will use Taylor series to approximate the exact solution of non-integrable function. By using the multiple-cycle motion method for the path planing, we can control the system to its desired final orientation. The next research subject of nonholonomic systems is a wheeled mobile robot. The interesting problem for this system is how to avoid the obstacles around the working enviroment, while searching for the shortest path to the desired destination. In this thesis, we will use the vertices of obstacles to construct the nodes of path. Using these nodes, we can find the shortest path that reaches the desired position and orientation. After solving the problem of path planning, path following is an another issue to study. We will directly feedback the current position and orientation of the mobile robot to determine the steering angle and rotating speed of the front wheel. Accordingly, this system can be followed on the planed path while it subjects to any disturbance. Using this method, we can overcome any worst enviroments, e.g. slippery ground and uneven macadam.

Keywords : Nonholonomic 系統 ; Nonholonomic 限制 ; Nonholonomic System ; Nonholonomic Constraint ; Space Robot ; Mobile Robot ; Path Planning ; Path Following

Table of Contents