DYNAMICAL MODEL OF MOBILE ROBOT INCLUDING SLIPPING OF CARRYING OBJECTS

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ABSTRACT. Force and torque induced by the traveling motion of a mobile robot dynamically affects the objects being carried on it. If the induced inertia force and torque are larger than the static friction force and torque, the carried objects begin to slip on the mobile robot. The final objective of this research was to construct a guidance controller that could travel as quickly as possible and prevent the carried objects from slipping. To achieve this, we modeled a mobile robot carrying plural objects to analyze their slipping motions and the influence slipping had on the traveling motion. The results of simulations were compared to actual slipping results obtained from experiments using a real mobile robot. The agreement between simulated and experimented results indicated that the proposed model could correctly describe the motion of the mobile robot carrying objects.

Keywords: Mobile robot, Dynamical model, Carried object, Slipping object

1. Introduction. Robots have played an important role in various kinds of factories in recent years. They have been utilized in factories to construct effective production systems, and to promote automation and unmanned production. However, many industrial robots in practical use are fixed to the floor, limiting their areas of operation. If they had the ability to move freely, their operational area could be expanded. A further distinctive feature of mobile robots is that they can move to places where jobs are required to be done according to task demands by the total production control system. This feature increases their operational rate.

Motion of a mobile robot is dominated by dynamics and kinematics, which is referred as “non-holonomic constraint”. In previous research, Muir [1] formulated a kinematical model of a wheeled mobile robot, and dynamical models have also been proposed [2-4].