DEVELOPMENT OF A DRIVE WHEEL CONTROL SYSTEM TO REDUCE STEERING FORCE WHEN WHEELCHAIR AND MPM ARE COUPLED

No. 2281295 Naoto Watanabe

(Supervised by Prof. Masaya Watada)

ABSTRACT

One of the social problems facing our country in recent years is care for the aged. Caregiving by the elderly is physically and mentally taxing. In addition, a high percentage of the elderly are physically disabled, and many have difficulty walking. As a result, many elderly people are wheelchair users, and their caregivers are forced to assist them in wheelchairs. However, wheelchair assistance for elderly caregivers is particularly physically burdensome and dangerous. Because of the danger of caregiving for the elderly, measures to reduce the burden of caregiving are necessary. In this study, we focused on the use of multi-purpose mobility (mPm) to reduce the burden of wheelchair caregivers. mPm can be connected to a wheelchair, allowing the caregiver to maneuver the wheelchair without using his or her own legs and feet. However, one of the challenges of coupled driving is that the steering force required to operate the mPm handle increases. The increase in steering force causes problems such as "difficulty in maneuvering the wheelchair by a person with limited strength" and "reduced agility due to slower steering operation. Therefore, this paper describes a drive wheel control system to reduce the steering force of mPm. By generating a difference in rotational speed between the left and right drive wheels, a turn is made by creating a difference in the amount of forward motion of the wheels. Turning by the drive wheels reduces the amount of steering force by decreasing the amount of turning by steering the steering wheel. Experiments were conducted to verify the reduction of steering force by the difference in rotation speed of the drive wheels, and it was found that providing an appropriate difference in rotation speed for the size of the turning radius is a method that can efficiently reduce steering force. Therefore, experiments were conducted to measure steering force at multiple turning radii. As a result, it was found that the rotational speed difference at which the steering force is reduced varies depending on the size of the turning radius. In addition, it was possible to present the rotational speed difference at which the steering force is reduced at turning radii of 0.875~3.0 [m]. However, since the reduction in steering force was small, we investigated a new driving wheel action, a control to rotate only one wheel during turning. As a result of a steering force measurement experiment using one-wheel driving, a reduction in steering force of 2 to 3 times was obtained compared to driving with both wheels. Finally, we succeeded in reducing the steering force by about 25[%] compared to when the drive wheels rotated at a constant speed.