

## SKILL-ASSIST CONTROL OF AN OMNI-DIRECTIONAL WHEELCHAIR BY NEURO-FUZZY SYSTEMS USING ATTENDANTS' FORCE INPUT

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**ABSTRACT.** *This paper presents a novel skill-assist (or power-assist) method which employs neuro-fuzzy systems in an Omni-directional Wheelchair (OMW). This function allows the attendants of elderly or handicapped people to deal with heavy loads while the operability problem of moving the OMW laterally or rotating it around the OMW's Center of Gravity (CG) is also solved. A fuzzy reasoning method is proposed for estimating the navigation direction according to the force exerted by the attendants against the handgrips of the OMW. A neuro-fuzzy system (ANFIS) is used for auto-tuning the fuzzy system's membership functions according to each attendant's individual characteristics based on the attendant's input data. Further, a second-order lag controller which transforms the force applied by the attendant into the OMW's velocity is presented for enhancing the comfort of the OMW's occupant. The usefulness of the proposed method is demonstrated through simulation and experiments.*

**Keywords:** Omni-directional wheelchair, Skill-assist system, Power-assist, Neuro-fuzzy system, Operability

**1. Introduction.** According to a report published in 2002 by the Department of Economic and Social Affairs, Population Division, of the United Nations, by the year 2025 aged people, or those more than 60 years old, will comprise 15% of the world's total population, and by the year 2050 this figure will reach 22.1%, compared with 10% in the year 2000. Moreover, according to a report published in 2001 by the International Day of Disabled Persons, around 10% of the world's population is comprised of disabled people. This means that by 2025 around 1/5 of the world's total population will need some kind of artificial perambulatory assistance in their daily lives.

For those aging or disabled people whose condition makes them unable to use mobility aids such as canes, crutches, or walkers, wheelchairs can provide many benefits,