Scientific/Educational Workshop

Workshop title

Robotic wheelchairs: Current trends and objective quantification to improve driving performance

Workshop organizer

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Speakers

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Workshop goals

- Describe the importance of Electric Powered Wheelchair (EPW) technology
- Describe the design limitations of current EPW technology
- List the different types of novel robotic wheelchairs
- Discuss key evaluation strategies of novel robotic EPWs (e.g. usability metrics – effectiveness, efficacy, satisfaction)
- Define Quantitative Driving Performance Metrics (QDM) and discuss its key applications

Abstract

Electric powered wheelchairs (EPWs) are key assistive technology devices for people with disabilities who use them as a primary means of mobility. However, existing EPWs are commonly designed for indoor environments or paved outdoors, predisposing to loss of stability leading to tips and falls in outdoor environments. Every year, over 100,000 nonfatal wheelchair- related accidents are reported in the United States alone. An estimated 65-80% of such wheelchair-related accidents and injuries are due to tips and falls encountered by users when navigating hazardous terrains in outdoor environments. The developments in sensing technology have enabled researchers to design novel robotic EPWs that can enhance the safety of EPWs. Aim 1 of this session is to discuss the common driving challenges experienced by EPW users highlighting the design limitations of existing devices and illustrate the evolution of a novel robotic EPW called MEBot, intended to address these limitations. The Mobility Enhancement roBot (MEBot) is a novel robotic EPW comprising of six independently height-adjustable wheels, a modular base, and a footprint similar to existing commercial EPWs. These technical features provide advanced mobility applications such as active suspension to increase the users' stability when navigating uneven terrains and a curb climbing application to improve accessibility and user's independency. Clinical EPW driving assessment tools play a significant role in evaluating users' ability to drive EPWs, and offer training to improve EPW driving capacity. However, existing EPW driving assessment tools provide limited information about novel EPW's effectiveness to aid users' performance. Aim 2 of this session is to describe the development of novel quantitative driving performance metrics (QDM), a set of objective variables to quantify EPW driving capacity. Data will be presented to demonstrate the application of QDM to evaluate the MEBot's usability.