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# DESIGN OF A PASSIVE EXOSKELETON TO SUPPORT SIT-TO-STAND MOVEMENT: A 2D MODEL FOR THE DYNAMIC ANALYSIS OF MOTION

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**Summary:** A significant number of people worldwide suffer from musculoskeletal pathologies, which result in limitations during locomotion and even while performing sit-to-stand (STS) movement. Causes can be associated not only to traumatic events, but also to degenerative diseases or stroke, and its severity tends to aggravate with age. Allowing disabled people to stand, even if during small periods, can reduce secondary conditions and improve emotional factors, resulting in an increase of their life expectancy and reducing healthcare costs.

The aim of this project is to develop a passive exoskeleton to support sit-to-stand movement. In order to design and develop this solution, a study of its kinematics and dynamics is required, so that reaction forces and moments at joints can be estimated. For that purpose, a computational tool based on two-dimensional multibody dynamics was developed and its results compared with validated software using reference models.

Data concerning STS movement, specifically kinematics and kinetics, was collected in a biomechanics laboratory using a motion capture system. Two movements were considered, namely STS with arm support and STS without arm support. A two-dimensional simplified biomechanical model was developed so that the collected data could be integrated in the computational tool. Outcomes include reaction forces and moments calculated at the ankle, knee and hip joints, giving insights about the torque and power requirements for the exoskeleton design.

Preliminary studies revealed that 10% of the force required to perform the standing motion can be granted through the user's arms action force. The obtained results will be used for the optimization of the model, concerning its structural design, actuation and control methodologies.