



## SIMULATING HOW LOWER-LIMBS EXOSKELETON IN SINGLE AND MULTI-JOINT CONFIGURATIONS INFLUENCES THE ASSISTANCE OF SIT-TO-STAND MOVEMENT

Denis Mosconi, Mechanical Engineering Department – University of São Paulo,  
[denis.mosconi@ifsp.edu.br](mailto:denis.mosconi@ifsp.edu.br)

Adriano A. G. Siqueira, Center of Engineering Applied to Healthy – University of São Paulo,  
[siqueira@sc.usp.br](mailto:siqueira@sc.usp.br)

**Abstract.** The sit-to-stand is a movement frequently performed during activities of daily living. The use of exoskeleton can improve the good performance of the movement, whether in clinical, domestic, industrial or military applications. However, it is necessary to understand the implications of using exoskeletons under different joint configurations. The purpose of this work was to perform computational simulations with a human-exoskeleton model in order to study how different configurations of the exoskeleton influence the sit-to-stand movement. To this, eight simulations were performed: one with the model without exoskeleton, three with single joint configuration and four with multi-joint configuration. There was analyzed the movement performed, robot torque and muscles activations. The data obtained allow us to conclude that the robot causes a change in the movement performed by the person, compared to the movement performed without assistance (bare mode). However, for any configuration, a reduction of muscle activations is observed, which influences the human energy consumption as well as promotes a reduction of muscle fatigue.

**Keywords:** Biomechanical Simulation. Human Neuromusculoskeletal Model. OpenSim. Predictive Simulation.