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# MULTIBODY MODEL OF THE COLLABORATIVE HUMAN-INSPIRED ROBOT CHARMIE

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## ABSTRACT

*With the worldwide ageing of population, domestic robots can provide important aid by assisting elderly persons with mobility limitations, increasing their autonomy, while reducing caretaker fatigue. Currently, a human-like mobile system, called CHARMIE, is being assembled, which can be applied for those situations. For this purpose, a full multibody model has been developed, which allows for the assessment of the robot's performance as well as its structural analysis and actuators' selection. The robot multibody model consists of 40 rigid bodies, interconnected by 34 ideal revolute joints, 10 translational joints, and three rigid joints, resulting in a total of 21 degrees of freedom, namely three for the locomotion, two for the hip, seven for each arm and two for the neck. The system is driven by four linear actuators and 17 motors. The multibody dynamic simulations use an in-house software structured around two approaches: a recursive forward kinematics algorithm based on Euler angles, and a recursive Newton-Euler formulation for solving inverse dynamics. For implementing these approaches, the robot has been modelled as three serial kinematic chains, all starting from its base and finishing in the left end-effector, right end-effector, and head respectively. This work focuses on the model developed for the motion simulation of CHARMIE. The proposed methodology includes seven main steps: (i) identify the main bodies and kinematic chains; (ii) convert the body properties into the required software inputs; (iii) analyze the geometry of the indirectly actuated joints; (iv) model the kinematics of the main bodies with the first recursive algorithm; (v) determine the kinematics of additional bodies; (vi) solve the inverse dynamics of the main bodies with the second recursive algorithm; (vii) manually compute the dynamics of the closed and overconstrained loops. The overall outcomes produced have been validated against those obtained by a commercial software.*

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