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# A NOVEL METHODOLOGY TO RESTRICT THE RANGE OF MOTION OF HUMAN ARTICULATIONS

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## ABSTRACT

*The human movement has long been a subject of extensive investigation by many authors, involving a vast interest in both clinical and sports applications. The use of biomechanical models of the human body can greatly contribute to the advancement of the body of knowledge in this scientific field as they provide rigorous information on several key biomechanical parameters. Thus, the modeling of human articulations must realistically reproduce their behavior and, therefore, to consider a restricted range of motion (RoM). The RoM is influenced by the bony structures adjacent to the articulations and by the physiological characteristics of the connective tissues, such as muscles and ligaments, surrounding them. This parameter varies amongst subjects and according to the type and anatomical location of each articulation. However, in the multibody systems methodology, the violation of the RoM for a particular joint can be clearly noted if geometrically ideal joints are used. This occurs since no additional constraints are introduced in the joint's formulation to prevent it from acquiring unfeasible positions. To provide a solution for this problem, in this work, a novel methodology to restrict the RoM of human articulations is proposed within the framework of multibody systems methodologies. Joint resistance moments are applied to simulate the passive resistant behavior of the connective tissues existing around human articulations and to prevent physiologically unfeasible positions of the contiguous bony structures. A three-dimensional biomechanical model of the human lower leg and foot is used as a demonstrative example of application of the proposed methodology, focusing on the ankle articular complex. The results compare the dynamic behavior of the model with and without the application of the joint resistance moments and lead to the conclusion that the proposed methodology allows the correct restriction of the joints' RoM, while preserving the mechanical energy of the system.*

*Keywords: Range of motion, Joint resistance, Biomechanical modeling, Multibody dynamics*

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