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A FOOT-GROUND CONTACT MODEL FOR HUMAN MOTION ANALYSIS

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ABSTRACT

Over the last decades, there has been a growing interest in the area of contact-impact modeling and analysis in the context of multibody system dynamics. However, it remains a difficult task to accurately model the contact mechanics when the geometric and material properties are of complex natures, such as in the case of the human foot-ground interaction. Bearing that in mind, the foot is the main source of interaction with the surrounding environment for most people, since it is the only part of the human body that is in contact with the ground and, therefore, contact models that describe the human foot-ground interaction are of extreme importance for biomechanical analysis. Thus, to accurately replicate the human motion during the analysis of biomechanical multibody systems, the computational models must consider realistic representations of the foot and appropriate numerical descriptions of its interaction with the ground surface. In this sense, the main purpose of this work is to present a two-dimensional biomechanical multibody model to describe the foot-ground contact. The interaction between the foot and the ground is geometrically defined by circles positioned at specific locations on the foot plantar surface, and a plane, describing the ground. The contact is detected based on the relative interpenetration of the surfaces, and appropriate constitutive laws associated with the normal and tangential forces developed during the contact are applied. With the purpose of correctly determining the contact forces, an optimization process is implemented to obtain the most suitable values for the geometric and contact parameters of the proposed model. Finally, the results obtained from computational and experimental analysis are compared using a multibody model of the right side of human body, with the aim of validating the proposed approach.

Keywords: Biomechanics; Human Gait; Multibody Systems Formulation; Foot-Ground Contact Model

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