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Research Article

Mathematical Modelling and Simulation of the Bipodal Gait

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Abstract

In this article we present a mathematical model of the bipedal gait as well as the respective simulation of the joint movement that makes it possible. The data acquisition was carried out with the Tracker® software, and the dynamic simulation is presented in MATLAB® based on the obtained data. From this procedure, a perspective of the displacement generated by the lower train of the digitized human body is generated, which allows a study of the most concrete and successful movement for medical studies, since it allows the implementation of specialized designs and that meet specific characteristics in structures to reproduce the movement of the different joints.

Keywords: Mechanical motion, biomechanical, biomechatronics.

1. Introduction

The reproduction of the displacement generated by the inferior train of the human body is a key piece for the design and implementation of medical prothesis. The previous statement is one of the main reasons to develop this project since that by obtaining specialized simulations due everyone, allows the creation of structures with better adaptation to the characteristics of every single person than generic structures. This work allows to make a study of the movement that could be applied to physical projects to contribute to the development and implementation of structures capable of mimic the human gait. This phenomenon of movement has been widely studied in the literature and keeping in mind that, here is introduced one simulation method based on the tracking of the joints during the gait through the software Tracker® and then, with the data obtained it is carried out the specific dynamic simulation in MATLAB®.

The study of motion beyond the social ambit is an essential part of this project thinking in the engineering and medical applications in order to generate useful advancements in technology for the people with some sort of difficulties that require prothesis and not only for the inferior train since that the method can be extrapolated to track the motion of whatever part a dynamic process.

In the literature there are researches that present working approximations of mathematical models and simulations of the human gait to a prototype due posterior implementation. To know, the inferior extremities of human beings (legs and feet) are taken as a study object because it allows the development of working structures that consider the movement generated in the duty cycle of the gait.

The functions that describe the parameters for the walk first appear with a close relation of the segmentation of the extremity for the designing structure. To make the interpretation of such relations it has have been used software like MATLAB® to the simulation of the systems because it allows the visualization of variables like torques to get more stable structures, such that their parameters give response to the anthropometrical measures that guarantee that the models are going to fit to the individual standards.

The previous has had an impact in various fields of medicine, and its analysis has made it possible to improve the motion patterns through designs that lies on the segmentation of the extremity. Specifically, in [8] appears a prototype of an exoskeleton designed for a person and which main purpose was to analyze the response of the structure towards the reactions caused by the motion, and just like that been able to establish restrictions for future projects.

Currently, some of the models present significant weaknesses on the dynamic tracking due to data of the walk variables which might require very specific tracking techniques in order to satisfy the design requirements. Because of this it is sought to increase the tools of data acquisition that in general could be extrapolated to application of dynamic structures analysis.

2. Methods and Materials

A key concept to understand the work that is been developed in this document is the sequences of the gait. That is to say, the episodes of the displacement generated between the beginning of the movement and the phase right before the redoing of the sequence. In other words, the gait is a repetition of sequences in which every one of the inferior extremities go through by a stance phase (where the foot is touching the floor), a transitional phase also called the oscillation phase (where the foot leaves the floor and move forward to another contact point) and finally the arrival of the foot to that new contact point with the floor.

The oscillatory process is giving since the forefoot zone take off until the next contact with the floor. In association with the gait time, the step process is normally constituted by the initial inertial velocity of the subject that usually takes an

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