Apply Optimization Method to Predict the Anthropometric Data

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ABSTRACT

In musculoskeletal biomechanics, the modeling predictions of body joint reaction force have been extensively used. However, incomplete anthropometric data results in the estimation error. The present anthropometric data used for the biomechanical model are based on the Caucasian data. In order to have the anthropometric data of the local populations and to overcome the problem of the individual difference, we applied optimization techniques with a two-dimensional dynamic eight-links biomechanical model to predict the anthropometric data (mass ratios, centers of mass and coefficients of moment inertia of link segments) of the individual.

In this study, we developed a two-dimensional biomechanical model of eight-links segments, including hand, forearm, arm, head, trunk, thigh, lower leg and foot. In experiment, we used the Elite motion analysis system to record and analyze the human postures. The Kistler force plateforms were used to measure the ground reaction forces of the foot bottom. We then applied optimization techniques in minimizing the error between the estimated data from the biomechanical model and measured data from the plateforms. The estimated data and measured data included the ground reaction forces and application point of the ground reaction forces. The optimization algorithm used is Adaptive Simulated Annealing (ASA) was developed by Lester Ingber (1993). The unknowns in this optimization problem were the mass ratios, centers of mass and coefficients of moment inertia of the link segments. Eight subjects were recruited in this study. The results of eight-links segments in eight subjects showed that high individual difference was seen due to different body shapes of eight subjects. However, the average data of the eight subjects showed only 4% difference with the Caucasian data.

Key Words: Anthropometric data, Biomechanical model, Optimization method
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