Motion Planning for Gait Initiation Focusing on Anticipatory Postural Adjustment

In the super-aging society, it is becoming increasingly important to solve the problem of human gait initiation. An anticipatory postural adjustment, in which the position of the center of plantar pressure (COP) moves backward during the stance phase, has been observed during gait initiation. Anticipatory postural adjustment has been observed in the elderly and Parkinson's disease patients, which is different from that in normal subjects, and is considered to be a cause of falls. Therefore, it is important to understand the action plan of anticipatory postural adjustment in the gait initiation in detail, but since anticipatory postural adjustment is an unconscious movement, it is not easy to investigate whether or not the patient falls without anticipatory postural adjustment in the gait initiation by a subject experiment approach. This has not been verified. In this study, we propose a simple mathematical model of gait initiation and show that anticipatory postural adjustment occurs, thereby deepening our understanding of action planning for anticipatory postural adjustment in gait initiation. A body model called a musculoskeletal model, which models the human body, is operated with a simple control model such as muscle length feedback. More than 1800 control parameters, such as feedback gains, are adjusted by optimization, and the anticipatory postural adjustment resulting from optimization is analyzed. The results show that the model can reproduce the movements from standing to gait initiation and gait, and reproduces the anticipatory postural adjustment that the COP moves backward, indicating that the anticipatory postural adjustment is effective for the gait initiation. We expect that these results will contribute to a better understanding of anticipatory postural adjustment during gait initiation, which is different from that of normal subjects in the elderly and people with Parkinson's disease, and the relationship between anticipatory postural adjustment during gait initiation and falls.

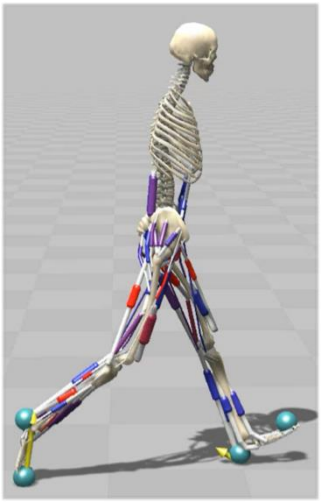

Figure 1. Musculoskeletal Model

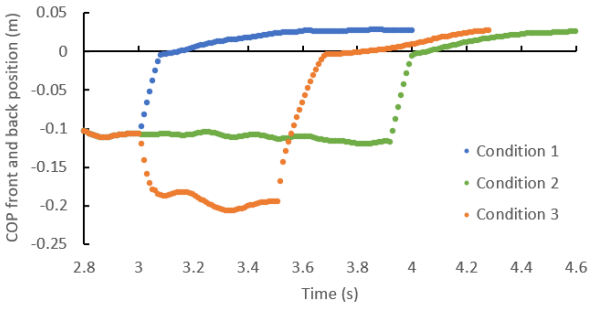

Figure 2. COP anterior-posterior position at the start of

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