Development of balance assessment system via estimation method of center of gravity based on a human mechanical model

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1. Objective

Balance assessment based on center of pressure (COP) measurement is widely used, but has an accuracy problem. While the use of center of gravity (COG) rather than the COP allows to assess the balance accurately, it is necessary to measure the COG in practical methods. The purpose of this study is to develop a camera-less COG estimation method to evaluate body balance in humans using force plates and inertial sensors.

2. Project Outline

The target human movements are rest standing, sitting, and one-legged standing. Horizontal swaying of the support surface of these movements may be applied for more accurate balance assessment. This study assesses the human balance during these exercises and shows the effects of aging and diseases.

3. Expected Performance

(a) While a subject is standing at rest, estimate the COG position and joint strategy in order to diagnose disorders due to aging and disease

(b) While a subject is in a sitting position, estimate the COG of the upper body and use it to diagnose patients with low back pain

(c) While an athlete subject is standing on one leg, estimate the COG and ankle torque to evaluate balance and recovery from injuries such as damage to the anterior cruciate ligament.

4. Required Skills and Knowledge

(a) A fundamental knowledge of dynamics based on the equations of motion

(b) Basic programing skills to perform numerical analysis (MATLAB or C++)

(c) A resilient character and abundant intellectual curiosity

References

(1) Motomichi Sonobe and Kazuki Naruta, Personal balance modeling during standing on a moving board from force plate data, 15th International Conference on Motion and Vibration Control, 2020

(2) Motomichi Sonobe, Hirotaka Yamaguchi and Junichi Hino, Frontal plane modelling of human dynamics during standing in narrow-stance, 13th International Conference on Motion and Vibration Control, 2016

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