

Modeling of Quiet Standing Postural Control

Human beings achieve postural control through the coordination of whole body muscle activities under the control of sophisticated nervous system. Clarification of standing postural control mechanism makes significant contribution to the field of physiology. We found that the composition of muscle tension includes not only tension for keeping balance but also one for exciting whole body's muscle activity. However, the model of it hasn't been created yet.

The purpose of the research is to model brain cortex – reticular formation – spinal tract control system for postural maintenance during the quiet standing. We hypothesized that both balance control system, constructing the muscle synergies, and feed-forward control system, increasing whole body's activity, exist for standing postural control. Control model which represents the function of them is to be presented.

To achieve the goal, a simulator has been created based on musculo-skeletal model which is able to represent the motion of quiet standing in order to evaluate function of balance control system and simple feed-forward control system quantitatively. In addition, according to the physiology knowledge, frequency of body's tremor during postural control is 10HZ, so that whether postural control can be realized when sample time of balance control system is 100ms is to be validated. Then, the function of reticulospinal tract during postural control is able to be evaluated quantitatively based on motion commands of muscle synergies which are responsible for balance control, whole body's excitatory activity, and sample time of balance control system.

The simulator with essential joints and segment, shown in Fig.1, was developed in OpenSim. As the first step of the research, feed-forward control system, without balance control system, was simulated to validate the motion output of the simulator.

Keywords: Postural control, Musculo-skeletal model, Reticulospinal tract model

Reference

[1] R. Chiba, H. Ogawa, K. Takakusaki, H. Asama and J. Ota, Muscle Activities Changing Model by Difference in Sensory Inputs on Human Posture Control, Advances in Intelligent Systems and Computing, vol. 194, 479/497, 2013.

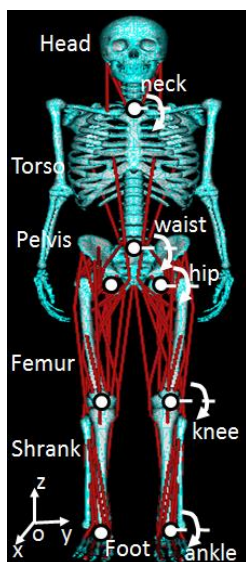


Fig.1 Simulator based on musculo-skeletal model

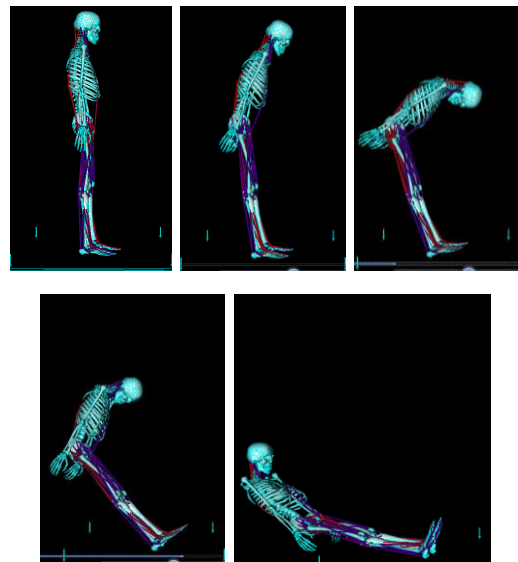
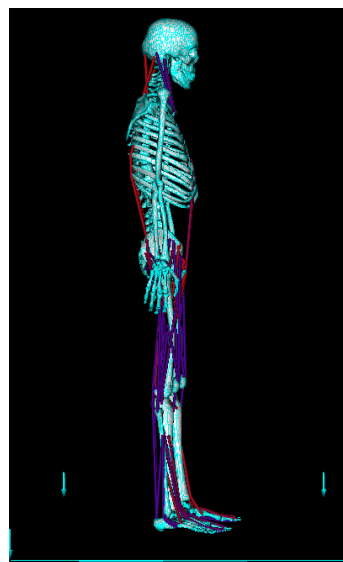


Fig.2 Simulation for body increasing activity model