Modeling of Standing Postural Control

Clarification of standing postural control mechanism makes significant contribution to understandings of nervous system and planning of treatment for neurological patients. Physiological researchers presented qualitative postural control models for quadrupedal walking based on experiments, but whether it also correspond to human stance postural control mechanism is not clear. On the other hand, engineering researchers always adopted an inverted pendulum model which neglected the muscles of humans.

Our objective is to validate whether the postural control model for quadrupedal stance of animals can also keep human standing; and to investigate the influence of feed-forward control on the postural control based on a musculoskeletal model with enough muscles.

We proposed two hypotheses:

1. Human postural control mechanism is composed of both feed-forward and feedback muscle tonus modulation control, as shown in Fig. 1.
2. The feed-forward control has a function of improvement of postural stability

To validate hypothesis 1. We increased delay time by 10ms increments to check whether FF and FF+FB can keep the musculoskeletal model standing when delay is 100ms.

To validate hypothesis 2. Under a certain delay, we compared the stability index (sway of joint) between FF+FB and FB to investigate which leads to better postural stability.

As a result, we found that both FB and FF+FB are able to keep the musculoskeletal model standing, implying that postural mechanism might consists of them. However, system including FF will have better stability, as shown in Fig. 2. Such a kind of function of stability improvement was supposed to result from the working of reticulospinal tract. We will improve our control model and try to validate it based on some experimental data.

Keywords: postural control, musculoskeletal model, biological simulation

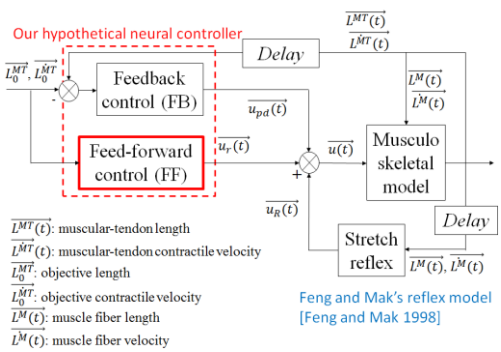

Fig. 1 Stance postural control model

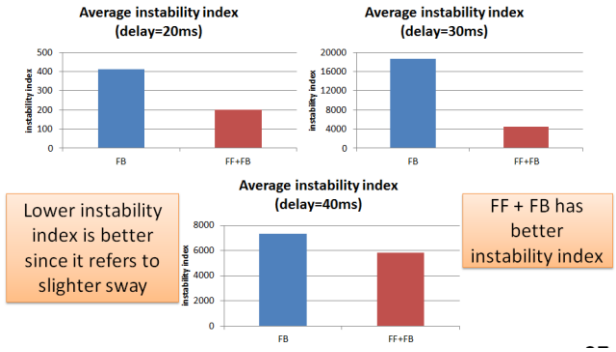

Fig. 2 Stability index