Multiscale Neural Simulation Platform for Sharing and Integrating Neuroscience Knowledge

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Purpose of this study is to develop neural simulator that can calculate both microscopic and macroscopic states of the nervous system, since there is an urgent need for the technological development which is applicable to diagnosis, treatment and prevention of nervous diseases which cause movement disorders because of the rapid aging of this country. The strategy for building neural simulator is to combine top down approach and bottom up approach. This talk is organized according to these approaches.

Top down approach includes building macroscopic anatomical nervous systems model which can be connected to the musculoskeletal model. We can acquire neural information by analyzing whole-body muscle data, because the nervous system controls the musculoskeletal system and lengths and forces information is fed back to the nervous system. Motor information is calculated by mapping motion-capture data on to a musculoskeletal human model. Neural information represents the set of motor information on the muscles innervated by the arbitrary segment. Neural information processing is proposed which calculates correlation among the neural information. The effectiveness of the proposal was demonstrated by experimental results of whole body motion.

Bottom up approach includes interfacing microscopic anatomical and physiological neural models to the macroscopic model. Fortunately, a variety of microscopic neural models are registered on neural model databases, which are created and reviewed by neuroscientists. We should be able to develop a simulator which is composed of reliable partial models, if we take advantage of them. However, reusing these models requires much time and labor, because the variables and parameters are not annotated. Also, each model doesn't consider connectivity to other models since the models are originally developed for particular experiments. We proposed a novel method for reassembly and interfacing models registered on biological model databases in order to integrate these models. The method was applied to the neural models registered on one of the typical biological model database, ModelDB.

Keywords

modeling, simulation, biological database, biological process, neuroinformatics