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A Parallel-Hierarchical Neural Network Model for Motor Control of A Musculo-skeletal System

- Neural Network Model with Hierarchical Objective Functions -

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ABSTRACT

This paper propose a new *parallel-hierarchical neural network* model to enable motor learning for simultaneous control of both trajectory and force, by integrating Hogan's control method and our previous neural network control model using a *feedback-error-learning* scheme. Furthermore, two *hierarchical control laws* which apply to the model are derived by using the Moore-Penrose pseudo-inverse matrix: one is related to the *minimum muscle-tension-change* trajectory; and the other is related to the *minimum motor-command-change* trajectory. The human arm is redundant at the dynamics level since joint torque is generated by agonist and antagonist muscles. Therefore, acquisition of the inverse model is an ill-posed problem. However, the combination of these control laws and feedback-error-learning resolves the ill-posed problem. Finally, the efficiency of the parallel-hierarchical neural network model is shown by learning experiments using an artificial muscle arm and computer simulations.