研究テーマ　モデリングに基礎をおく制御手法の実装に関する研究

研究者	Zhao Lichu	財団法人みやぎ産業振興機構	派遣研究員
	星宮　望	東北大学大学院工学研究科	共同研究員
	二見亮弘	東北大学大学院工学研究科	共同研究員
	渡邉高志	東北大学大学院工学研究科	共同研究員

１　フェーズⅠ

(1)　研究の概要

To get the stimulation pattern for arm reaching movement, several technologies have been proposed, such as optimization and neural network technology. But unfortunately for optimization method, when the number of parameters needed to be optimized is very large, the optimizing speed would be very slow and meanwhile it could not guarantee converging to the optimal solution. Therefore, the inverse dynamics learning of the human arm is of great importance for determining the given task's stimulation patterns. In order to establish the inverse dynamics of the human arm, two methods, the direct inverse dynamics modeling and the forward and inverse dynamics modeling, are implemented. First, the random stimulation patterns are used to get the relationship between stimulus and joint angles, where it could contain the overall features within the specific domain; secondly, train the forward dynamics neural network using this data and suppose this neural network could represent the real forward dynamics of the human arm; thirdly, the direct inverse dynamics modeling and the forward and inverse dynamics modeling are learned. In order to establish the more realistic human upper extremity model, more non-linearity should be incorporated into the muscle model, where J.Winters' model is also selected for studying.

(2)　研究の目標

- Set up the human multi-joint arm models using J.Winters' muscle model for simulations
- Implement the Minimum Stimulus Change Model for determination of stimulation patterns.
- Establish the relationship between the muscle stimulation patterns and joint angles.
- Establish the forward dynamics neural network
- Implement direct inverse modeling and Forward and inverse modeling.

(3) 実施内容

- Muscle is modeled as the J.Winters' muscle model
- Stimulation patterns with frequency 20Hz and duty 20 are adopted to get the stimulation patterns using optimization technology by minimizing the Angular Jerk Change Model.
- Random stimulation patterns are used to obtain the relationship between the stimulus and joint angles, which are used as the training data for the Neural Networks representing the inverse dynamics and forward dynamics of human arm model.
- Different topologies of Neural Networks are implemented and compared.

(4) 結果

- The platform for upper extremity is established.
- Stimulation patterns for arm reaching movements are determined by minimizing the error between the desired and actual trajectory.
- Direct inverse dynamics modeling is established.
- Forward and inverse dynamics modeling is established.

2 フェーズⅡ以降

- Establish the more realistic human arm model, which is a valid representation of the real system constraints and experimental conditions.
- Speed up the procedure to get the stimulation patterns given the task.
- Obtain the more reliable relationship between the stimulation patterns and joint angles.
- Incorporate the Feedback Controller in learning the inverse dynamics.
- Implement the Feedback Error Learning modeling.