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Genetically-designed Neural Networks for Error Reduction in an Optimized Biomechanical Model of the Human Elbow Joint Complex

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Abstract

A real time dynamic biomechanical model of the human elbow joint has been used as the first step in the process of calculating time varying joint position from the electromyograms (EMGs) of eight muscles crossing the joint. Since calculation of position has a high sensitivity to errors in the model torque calculation, a genetic algorithm (GA) neural network (NN) has been developed for automatic error reduction in the dynamic model. Genetic algorithms are used to design many neural network structures during a preliminary trial effort, and then each network's performance is ranked to choose a trained network that represents the most accurate result. Experimental results from three subjects have shown model error reduction in 84.2%

of the data sets from a subject on which the model had been trained, and 52.6% of the data sets from the subjects on which the model had not been trained.

Furthermore, the GA networks reduced the error standard deviation across all subjects, showing that progress in error reduction was made evenly across all data sets.

Keywords: Biomechanics Elbow joint Genetic algorithm Neural network Optimization