

Evaluation of Closed-Loop Control System for Restoring Standing and Sitting Functions by Functional Electrical Stimulation

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摘要

Abstract

Functional electrical stimulation (PES) is a method for restoring the functional movements of paraplegic or patients with spinal cord injuries. However, the selection of parameters that control the restoration of standing up and sitting functions has not been extensively investigated. This work provides a method for choosing the four main items involved in evaluating the strategies for sit-stand-sit movements with the aid of a modified walker. The control method uses the arm-supported force and the angles of the legs as feedback signals to change the intensity of the electrical stimulation of the leg muscles. The control parameters, K_i and K_p , are vary for different control strategies. Four items are collected through questionnaires and used for evaluation. They are the maximum reactions of the two hands, the average reaction of the two hands, largest absolute angular velocity of the knee joints, and the sit-stand-sit duration time. The experimental data are normalized to facilitate comparison. Weighting factors are obtained and analyzed from questionnaires answered by experts and are added to evaluation process for manipulation. The results show that the best strategy is the closed-loop control with parameters $K_i= 0.5$ and $K_p=0$.