INSTYTUT MECHANIKI TEORETYCZNEJ I STOSOWANEJ
Wydział Mechaniczny Technologiczny
Politechnika Śląska

ROZPRAWA DOKTORSKA

Dobór parametrów regulatorów w systemie sterowania urządzeniem do reedukacji chodu

mgr inż. Grzegorz Gembalczyk

Promotor
dr hab. inż. Sławomir Duda

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Abstract

The doctoral thesis presents a results of working on adjusting parameters of regulators in the control system of a mechatronic device designed for supporting the process of gait reeducation.

The purpose of the doctoral thesis was to develop and optimize algorithms that control the functions of the drive systems of the device. Because of the modular construction and the functionality of the device, planning the control systems was done separately for the three main components:

- body weight support system (technologically advanced winch) responsible for maintaining constant value of the relief force,
- drive of the winch trolley, which realizes the follow-up movement in patients coronal plane,
- drive of the training treadmill, which speed is adjusted by the walking tempo of the patient.

The process of planning the control system was conducted with use of the Model-Based Design method, which is based on numerical models.

This work shows also the method for modeling mechatronic drive systems and the process of estimating the parameters. The identification of the compiled servo drive models was executed through experimental research conducted under varied load conditions.

The body weight support control system uses fuzzy logic coupled with the PID controller. Furthermore, a follow-up control system with a PID regulator was used in the movement control system of the winch cart. The regulators' settings were selected through the optimization process that was conducted with a hybrid method.

The treadmill speed adaptation is enabled through simulating the control buttons pressing. This solution was made possible by means of additional controller, which was built with optoisolators controlled by a digital signal. The speed adaptation algorithm required developing a rectangular periodically variable signal generator, which frequency depends on the angle of the rope inclination.

The designed control system was verified by experimental research, which results depict that the device functions are correct and consistent with the design criteria.