

THE MATHEMATICAL MODELLING OF HUMAN UPPER LIMB AS AN ASSISTANCE IN THE REHABILITATION PROCESS

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The paper presents a method of experimental and model investigations, enabling the monitoring of rehabilitation process, for patients with upper limbs diseases, having neurological base. The changes of forces, generated by particular groups of upper limb muscles, during typical rehabilitation exercises, were assumed as an indicator of the rehabilitation progress. The mathematical model and the set of computer programs were elaborated, which enable identification of forces generated by muscles and realization of comparative analysis, within a framework of inverse dynamic problem, and with the use of optimization techniques and computer processed video-registration of limb movement.

Key words: human upper limb, mathematical modelling, muscular forces identification, rehabilitation

1. Introduction

Great importance of prehensile, tactile, sensing and forcing functions, performed by human upper limb, and its susceptibility to injuries and pathologies, cause great interest in investigation of its motion among orthopedists, sport doctors, rehabilitants and biomechanical engineers. An knowledge of forces, generated by muscles, acting on elements of limb in different states of load, during different movements, is very important, especially in prosthetics, sport or in rehabilitation process, for evaluation of its progress and selection of best therapeutic exercises [1].

Evaluation of rehabilitation progress is actually based mainly on subjective observations of physician. Modern methods of treatment and rehabilitation should enable full and objective evaluation, comparison and recording of the effects of applied therapeutic methods. Direct, noninvasive measurement of forces, generated by individual muscles, still seems impossible. Development of computer technique and numerical methods, and achieved level of knowledge of principles of skeletal-muscular system functioning, created however the possibility of adequate mathematical modeling and reliable computer simulation of upper limb motion [2, 3, 4].

2. The aim of performed investigation

Presented work was aimed at elaboration of a method, enabling routine estimation and comparison of values of forces, generated by muscles of upper limb, and resulting loads of joints, during typical rehabilitation exercises. It was assumed, that the method will con-

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