INTELLIGENT ROBOTIC REHABILITATION SYSTEM FOR TREATMENT OF DISABILITIES SUBSEQUENT TO INJURIES OR NEUROLOGICAL DISORDERS

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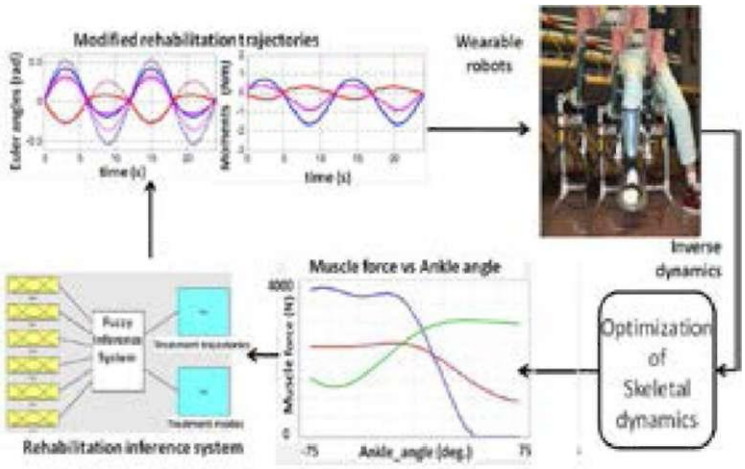
Introduction. Injuries or neurological trauma, such as stroke, complete and incomplete spinal cord injuries result in paraplegia and hemiplegia, which is the leading cause of disabilities world over. Survivors have muscle coordination discrepancies resulting in impaired joint motions and inability to perform activities of daily living (ADL). Neurological trauma falls in top 15 risk factors for Kazakhstan people and their health conditions. Urgent steps are required to be initiated as the current rate of such disorders is predicted to increase by three times over the next 30 years. Robot assisted physical therapy has shown some preliminary signs of improvement in subjects and therefore active orthosis have been developed to impart repetitive, prolonged and systematic therapy. Existing robots are normally inspired by the industrial robots and thus provide constrained motion to the articulating joints in an uncomfortable and unsafe manner. There is a need to develop human friendly, safe and intelligent robots in order to carry out physical therapy. We aim at developing an intelligent rehabilitation system (IRS) using wearable robots equipped with state of the art sensors and actuators, optimization routines (to identify musculoskeletal functions at the affected limb) and development of advanced controllers. Physical therapy is expected to be evidence based, objective and human friendly.



Design and Methodology. To achieve the desired aim, we intend to research specifically: (1) *Bio-inspired design of rehabilitation robots:* These robots shall be portable, compact, light weight and provide unconstrained joint motion to the subject by remaining compliant with the joint motions without slips. (2) *Combined robot and skeletal dynamics:* We have developed dynamic models of the robots and human skeletal systems combine. Experimental validation of these models is to be carried out. (3) *Identification of musculoskeletal functions:* Optimization routines to estimate the muscles activation using skeletal dynamics to be developed. Experiments using electromyography (EMG) can be performed to validate these routines. (4) *Evaluation of subject capabilities:* A fuzzy logic based software (FBS) shall be developed to evaluate musculoskeletal functions of subjects by comparing with the functions available from a generic biomechanical model. Subject specific treatment trajectories along with the rehabilitation training mode shall be the outputs from the proposed FBS. (5) *Adaptive interaction control:* An adaptive controller is also proposed to be developed to modify the robotic efforts in real time based on patient's disability level. (6) *Evaluation of the prototype system* shall be performed using experiments to propose improvements for their clinical version.

References.

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