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Energy-efficient Walking Mechanism for Gait Rehabilitation

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Introduction

Human inborn walking system has been evolved well-suited to walk in a manner that conserves energy and fast to adapt to new walking conditions in an energy efficient way. Deviations from the normal walking pattern increase the extra energy expenditure of walking around 70%, comorbidity with several side-effects for gait rehabilitation. Energy efficiency is important in robot-assist gait training. We try to propose an energy efficient walking mechanism, coexisting and cooperating with patient to reconstruct the new walking system on the process of gait rehabilitation. Optimizing the assistance pattern to maximum individual performance while reducing metabolic cost, fast adapting to non-steady-state walking conditions.

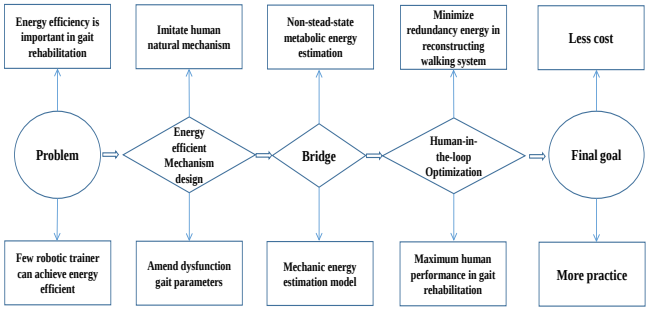

Fig.1. Overview of the project

Energy Efficient Mechanism for Rehab.

Normal gait is the most energy-efficient process, the design protocol for gait rehabilitation is: building assistance mechanism by understanding human natural mechanism. (1) Human-based: using redundancy energy in human natural musculoskeletal system. (2) Device-based: using high energy-efficient device instead of partial human gait. (3) Task-based: energy harvest in terms of neutralizing the gravity on the process of walking.

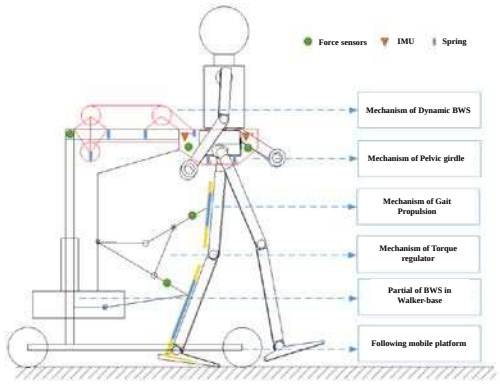

Fig.2. Sketch of energy-efficient mechanism

Human-in-the-loop Optimization

Taking human in the loop(HIL), to reduce the redundancy energy of reconstructing walking mechanism underlying the directly react of the physiological state of user. Proposing mechanic estimation model to shorten the time of metabolic estimation comparing with HIL optimization, fast to achieve energy efficient in rehabilitation.

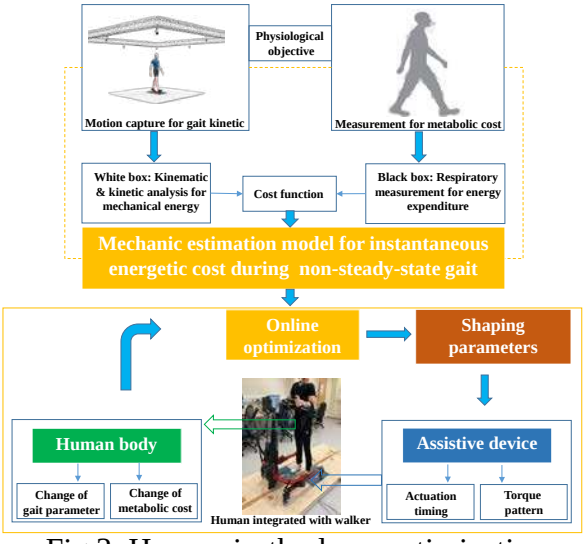

Fig.3. Human-in-the-loop optimization

Reference:
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