FYP: Biomechanic Simulation of Human Gait with assistive devices

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Background

Lower limb osteoartritis is a common medical condition which causes jont pain,stiffness, inflammation which hinders patient from basic daily life activities such as walking and running. Osteoartritis can be treated with physical therapy, medication, injection and joint replacement surgery. Which ever medical treatment is used, a rehabiliation device is required to reduce the joint load which is usually achieved by using crutches.

From studies, huge amount of the hip joint contact force during walking is due to abductor muscle force which plays a big role on maintaining the stability during single leg support in human gait. We would like to apply this concept to design an exoskeleton to reduce the hip load during walking.

Problem

Eventhough a lot of rehabiliation exoskeleton has been developed, little of them addresses hip abduction assist and none of them uses the approach of reducing abduction muscle force by weight support which also stabilizes the body. Therefore, we want to develop an exoskeleton that applies this concept.Before the design process, it is essential to investigate the interaction between human body and different external support and actuators with simulation. In this project, we are going to use OpenSim, a biomechanics simulator developed by Standord Unviversity which has been widely used in academia.

figure: Musculoskeletal model in OpenSim (left). ReWalk, a rehabiliation exoskeleton (right)

Objective

Simulate the muscloskeletal model with external mechanical component, determine the accuracy of result and analysis the physical effect of the extra part.The procedures inculde:

1. Modify the simulation model and simulate human gait with walking assist or body weight support system
2. Compare simulation result with experimental results in order to validate the simulation setup
3. Simulate different assistive devices which has not been simulated and determine the effectiveness of such devices

Requirements

One student in Mechanical, Aerospace, or Mechatronics

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