MECHANICAL ENGINEERING

CONTROL METHODOLOGIES FOR POWERED PROSTHETIC INTERVENTIONS IN UNILATERAL AND BILATERAL TRANSFEMORAL AMPUTEES

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Dissertation under the direction of Professor Michael Goldfarb

This dissertation describes the development and testing of control systems for powered transfemoral prostheses. The work is divided into seven chapters, with five distinct contributions. Chapter I provides introductory material, background, and some of the theoretical motivations behind the work. In Chapter II, a finite state-based locally passive impedance controller is described based on previous work and extended to achieve active stumble recovery mechanisms in level walking. In Chapter III, new state machines are introduced and implemented in order to perform stair ascent and descent in unilateral transfemoral amputees. In Chapter IV, a hybrid control approach is presented that simplifies the state machine and achieves continuously variable cadences. In Chapter V, a coordinated control scheme is presented for bilateral transfemoral amputees. Chapter VI describes and tests an algorithm that estimates the crank angle of a bicycle using measurements internal to the prosthesis. Chapter VII draws some conclusions about the work and discusses future directions.

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