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Abstract
The purpose of this thesis is to develop a dynamic model of biped locomotion and implement a suitable controller for it. The locomotion aimed to be realized in this thesis is walking on a flat horizontal surface in the sagittal plane. First, a planar five-link biped robot, which consists of a torso, two thighs and two shanks, with five degrees of freedom is modeled. A gait cycle of the walking motion includes the single support phase (SSP), the impact phase and the support end exchange phase. The dynamic equation at SSP is derived by using the Lagrangian formulation and the impact equation is derived by using the momentum change caused by the nonconservative force during impact and the constraint imposed on the impact leg. Meanwhile, compatible trajectories of the hip and the swing leg's tip are designed with polynomial functions of time and their coefficients are determined using the constraint equations imposed by of coherent physical characteristics of gait. These constraints are used to generate the trajectories of desired angular displacement, velocity and acceleration of each joint of the biped robot. Finally, backstepping control technique is used for controlling the biped locomotion system. The stability and the tracking performance of this technique are investigated. The simulation results demonstrate the effectiveness of the proposed approach.
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