Visual control of foot placement when walking over rough terrain

by

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ABSTRACT

When walking over flat terrain, humans achieve remarkably efficient gait cycles by exploiting the passive mechanical forces inherent to the biomechanical structure of bipedal locomotion. In such environments, the location of foot placements emerges naturally from the dynamics of the moving body. However, when walking in more complex, cluttered environments, the visual system must guide foot placement by identifying safe footholds that will allow the walker to maintain forward motion. In regions of extended rough terrain, the visual system must choose foothold locations in a manner that takes future obstacles into account in order to ensure smooth, uninterrupted walking. Furthermore, in order to approximate the energetic efficiency realized by a human walker in uncluttered terrain, the visual locomotor system must identify footholds that will maximally exploit the passive mechanical forces inherent in bipedal walking to guide the center of mass (COM) of the walker along the desired trajectory with minimal energetic cost. This thesis presents two experiments that investigate the role of visual information in the control of foot placement when walking in rough terrain. These experiments reveal that subjects are able to walk over complex terrain with normal levels of performance when they can see two or more steps ahead; when vision is constrained to less than two steps, subjects show degradation in speed and/or stepping accuracy. The results of these experiments are examined in the light of previous research on the biomechanics of bipedal gait, and other behavioral research on human walking. A potential theoretical explanation of the significance of the two step distance based on the biomechanics of bipedal gait is proposed.