Project Summary

Visual search plays a necessary role in the guidance of locomotor foot placement, particularly when walking across rough terrain where potential footholds are limited, and potentially hard to find. While there is a great deal of research investigating visual search and the biomechanics of locomotion independently, there is a gap in our understanding of their critical overlap. Visual search of natural environments has been shown to be highly fixation efficient and task specific, such that we might expect visual search during locomotion to incorporate the biomechanics of locomotion when making fixation efficient eye movements. A basic science understanding of the how visual search is influenced by biomechanical constraints will provide the foundation necessary for understanding how complex visuo-locomotor behavior might be affected by retinal and motor diseases. Therefore, the first goal of this project is to measure both the impact of locomotor task dependency (Aim 1) and visual search difficulty (Aim 2) on the utilization of biomechanical information during visual search for footholds. The second goal of this project is to conduct high quality measurements visuo-locomotor behavior in natural terrains, reconstructing the 3-D environment and mapping visual search and locomotor behaviors in 3-D space with high precision, paying close attention to how the preferred biomechanics might inform visual search behavior in the natural world.

Northeastern University provides an excellent interdisciplinary training environment required to fulfill the aims of this proposal. By combining the expertise from co-sponsors in visual neuroscience and motor neuroscience with the unique expertise of the sponsor – a world expert in the measurement of the visuo-locomotor system and the visual control of foot placement –, I will receive the training necessary to achieve the aims proposed.

This proposal will establish a new paradigm observing visuo-locomotor behavior in a large indoor laboratory space. In this paradigm, we will combine a 14x3m walkable Augmented Reality display with binocular eye tracking and full body kinematic motion capture to measure the visuo-locomotor system in unprecedented detail. Additionally, we will combine insights gleaned from laboratory experiments (Aims 1 and 2) with outdoor observation of natural visuo-locomotor behavior (Aim 3), testing the influence of biomechanical information in both controlled and unconstrained environments. The described research will lay the foundation for a better understanding of the connections between visual and motor neuroscience, and will provide a path for a career spent exploring complex perception and action systems.