Assessing Exposure to Slip, Trip, and Fall Hazards by Measuring Construction Worker Loss of Balance

Hoonyong Lee,[1] Gaang Lee,[2] SangHyun Lee,[3] and Changbum Ryan Ahn[4*]

[1]Department of Architecture, College of Architecture, Texas A&M University, Texas, USA; email: onarcher@tamu.edu
[2]Department of Civil and Environmental Engineering, University of Michigan, Michigan, USA. Email: gaang@umich.edu
[3]Professor, Department of Civil and Environmental Engineering, University of Michigan, Michigan, USA; email: shdpm@umich.edu
[4*]Associate Professor, Department of Construction Science, College of Architecture, Texas A&M University, Texas, USA (corresponding author); email: ryanahn@tamu.edu

ABSTRACT

A worker repeatedly exposed to slip, trip, and fall (STF) hazards is at an increased risk of an STF event. To monitor an individual's exposure to STF hazards, previous approaches have assessed the loss of body balance (LOB). However, these approaches were not fully validated in field settings, where dynamic workplace environments can impact workers' bodily movements. This study aims to develop and evaluate a new approach to assess workers' exposures to STF hazards by LOB assessment in a real construction site. A waist-worn Inertial Measurement Unit sensor was used to extract features of waist movements, which were modified into a single value to measure LOB using the Mahalanobis Distance (MD) metric. The MD value was calculated for each step a worker took, and exposure to the STF hazards was detected when the MD value was larger than a predetermined threshold. The results provided an average of an Unweighted Average Recall of 89.13% (without exposures: 90.30%, and with exposures: 87.96%) that would strongly indicate generalizability and robustness for practical applications.