

Inter-step Height Variation of Stairways and Observations of Fall-related Events

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ABSTRACT

INTRODUCTION: Variation in step height within a stairway could negatively impact safe stairway negotiation by decreasing step height predictability, and consequently, increasing stair users' fall risk. Unfortunately, inter-stairway step height variability is common, particularly in older stairways, but its impact may be lessened by highlighting steps' edges using high-contrast stripes on the top front edge of each step. Such contrast enhancement may draw greater attention to the steps' edges and potentially enhance the precision of the edge's estimated location. **PURPOSE:** To determine (1) if fall-related events are associated with greater inter-step height variation, and (2) if such fall-related events are reduced in the presence of contrast enhanced step edges compared to a control stairway. **METHODS:** Stair users were video recorded on two public stairways in a university building. One stairway had black vinyl strips applied to the step's edges and black-and-white vertical stripes on the last and top steps' faces. The stairway with striping was switched halfway through data collection. Each stair user recorded was coded for whether they experienced a fall-related event. **RESULTS:** Each flight of stairs had varying inter-step height (e.g., 14 mm for both West and East lower, 12 mm for the West upper, and 5 mm for the East upper). The flights that had 14 mm in inter-step height variation were associated with 80% of the fall-related events observed. 13 of 16 (81%) fall-related events occurred on the control stairway (no striping) compared to 3 of 16 (19%) on the high-contrast striping stairway. A Monte Carlo simulation was used to predict the probability of the distribution of fall-related events given our hypotheses. The distribution of fall-related events we observed between conditions likely did not occur by chance, $P = 0.0358$. **CONCLUSION:** These data support that a vision-based strategy (i.e., striping) may counteract fall-risk associated with high inter-step height variability. While the mechanisms of its action remain unclear, the high-contrast striping appears to have a positive impact on the incidence of fall-related events in the presence of high inter-step height variability.