Title: **Extension of the Target Achievement Control Test to an Immersive 3D Virtual Environment**

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Abstract

The Target Achievement Control (TAC) Test is a Fitts Law style developed to evaluate pattern recognition control systems [1]. The primary benefit of using this test is that it allows control performance of multiple degrees of freedom to be characterized while the user receives real-time feedback from a virtual limb moving on a computer screen. We have shown TAC test scores correlate strongly with several outcomes measures, including the Southampton Hand Assessment Procedure taken when users are controlling physical prostheses, whereas only weak, or no correlation is found with offline measurements such as the classification error-rate [2]. A limitation of prior implementations of the TAC test is that it was implemented on a 2D display. Furthermore, there are no restrictions on where the residual limb needed to be positioned in a functional workspace to acquire target postures. Here, we have created a 3D version of the TAC test using the HTC Vive Virtual Reality System (Figure 1). Using motion tracking we can track the user's residual limb position and enforce that they move through a reasonable workspace to reach 3D-rendered target postures. We tested this system with 8 intact limb control subjects using a dual task control test and

Figure 1: A subject wearing the EMG arm-cuff (blue), with the attached tracking puck (green). The immersive environment is rendered through the virtual reality headset (red).

compared results to performance achieved with a single task control test. We found significantly lower target completion rates ($p<0.05$) when completing the dual task test. This is presumably because of higher difficulty in holding the residual limb in a target location while simultaneously commanding the virtual limb into a target posture.

References

1. A Simon, L Hargrove, B Lock and T Kuiken, Target Achievement Control Test: evaluating real-time myoelectric pattern-recognition control of multifunctional upper-limb prostheses. *J Rehabil Res Dev* 2011; 48(6):619-627.
2. L. Hargrove, L. Miller, K. Turner, and T. Kuiken, Control within a virtual environment is correlated to functional outcomes when using a physical prosthesis. *JNER 2018*; 15:60.