International Neurorehabilitation Symposium (INRS), Toronto, Canada, 2019.

Evaluating Motor Compensation Techniques for Bilateral Upper Limb Reaching Caused by the Design of a Visually Augmented Task in Immersive VR for Youth with Hemiplegic Motor Disorders

Leia Shum, Bulmaro A. Valdés, H.F. Machiel Van der Loos

Error augmentation (EA) uses the concept of highlighting or accentuating deviations from motor goals to provide enhanced real-time feedback during rehabilitative exercises. With increased use of exergaming technology, exploration into visual error amplification of forward reaching tasks has begun. However, past studies have only evaluated the use of EA in 2D screen space while rotating the angle of reaching, whether in unimanual or bimanual tasks. Furthermore, exploration with immersive VR that can fully occlude vision of physical limb positioning has yet to be explored. In a single session experiment, the effectiveness of EA used to provide visual feedback for bilateral symmetry in two-handed reaching tasks is evaluated. The experiment was designed to explore bimanual reaching EA in a manner that directly compares the position of the weaker and stronger sides, while still evaluating the joint positions of the entire upper body. A cross-over design was used to allow each participant to train with and without visual EA applied in a blinded, randomized order with a 5-minute break in between sets. While preliminary results from typically developing teens and two participants with hemiplegic cerebral palsy show that error in reaching symmetry was quantitatively reduced, the variation of motor compensation techniques should be analyzed. Comparisons of trunk compensation, reach smoothness, and upper limb abduction causing elbow elevation for the two clinical participants found that compensation techniques occurred on the second training set regardless of order, likely caused by exercise fatigue. However, reach smoothness appeared to decrease in some cases for the training sets with EA, showing a larger amount of velocity peaks. In general, EA for bilateral symmetry may provide better goal results for those who can adapt but makes the training task more demanding. Further exploration into EA techniques that are reactive to previous trials in a training set is required.