Title: A Deep Learning Approach for Identification of Stroke-related Gait Features

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Background: Stroke is the leading cause of disability in adults worldwide affecting movement, speech, vision, and cognitive function. The majority of stroke survivors suffer walking dysfunction, thus improved walking is among their most frequently articulated goals. While rehabilitation is intended to reduce long-term disability and improve quality of life post-stroke, current rehabilitation outcomes are modest, at best. As a result, there is a significant unmet need for novel strategies and techniques to better understand and remediate walking dysfunction for stroke survivors. **Tools are needed to:** 1) facilitate identification of critical gait impairments that can better inform targeted rehabilitation strategies; 2) differentiate the more and less affected limbs based on quantified indicators of limb and joint movements, and 3) determine if alternative measurement strategies that do not require use of force plates can successfully identify gait impairments in stroke survivors and monitor recovery of walking function. **Methods:** Here, we present a deep learning method based on detection of gait characteristics in chronic stroke survivors. A sample of 31 study participants (19 stroke survivors, 12 healthy controls) walked at their self-selected walking speed on a split-belt instrumented treadmill. Data were quantified using a 12-camera motion capture system. A three-dimensional (3D) full-body biomechanical model was defined and used to extract kinematics and kinetics. Our method extracts temporal and spatial characteristics of joint movements and then uses an ensemble learning method to aggregate conventional neural network (CNN) [1][2] model techniques to: 1) identify patients with post-stroke gait dysfunction post, 2) reduce the number of joint movements required for the identification process, and 3) identify characteristics associated with the more and less affected sides of stroke survivors. **Results:** We have identified several deep learning techniques that: 1) differentiate stroke survivors from healthy controls with 95.16% accuracy, 2) identify joint movement characteristics of gait that correspond with the more affected vs. less affected sides with 100% accuracy. **Conclusion:** Our work manifests how the latest advances in machine learning technology [3] can be adapted to measure clinical outcomes and that may be used to inform clinical diagnosis and monitor disease progression and recovery.

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References:

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