Stroke

ABSTRACT Originally Published 30 January 2025

Abstract WP132: A Novel Approach of Monitoring Stroke Recovery: Contactless Sensor for Gait Speed and Fugl-Meyer Action Duration Estimation

Zhuangzhuang Gu, BS, Ryan Titus, BS, Hem Regmi, MS, Reza Tavasoli, BS, Sanjib Sur, Ph.D., and Souvik Sen, MD, MPH | AUTHOR INFO & AFFILIATIONS

Stroke Volume 56, Number Suppl_1 https://doi.org/10.1161/str.56.suppl_1.WP132

Abstract

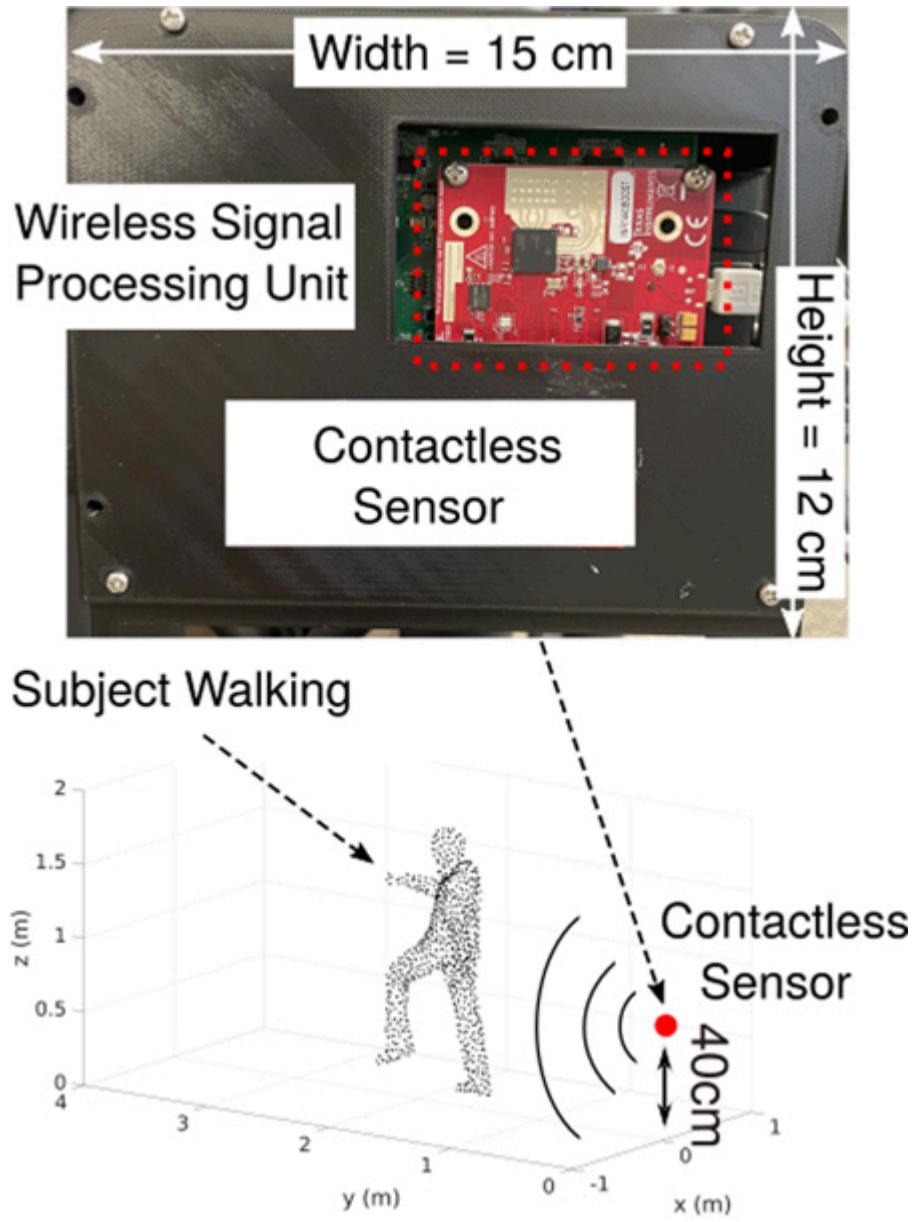
Objectives: Gait speed and motor deficits are key determinants of functional recovery, dependence, and disability in stroke survivors. Traditional methods of assessing these involve in-person observation and measurements by a healthcare provider. The objective of this study was to evaluate the accuracy of a contactless sensor to estimate gait speed and the duration of actions in a Fugl-Meyer (FM) assessment.

Methods: A contactless sensor with a processing unit was developed to estimate gait speed and FM action duration. The device transmits low-power radio-frequency signals (similar frequency used in 5G smartphones) and analyzes reflections from the subject's body. By filtering spatial and temporal frequencies, an algorithm identifies 3D body structure, separates walking periods, and calculates gait speed from time and distance. For FM actions, the algorithm identifies features associated with 3D movements of arms and legs, extracting segments with the highest feature template matching. We compared the contactless sensor measurements with the standard manual measurements (Figures).

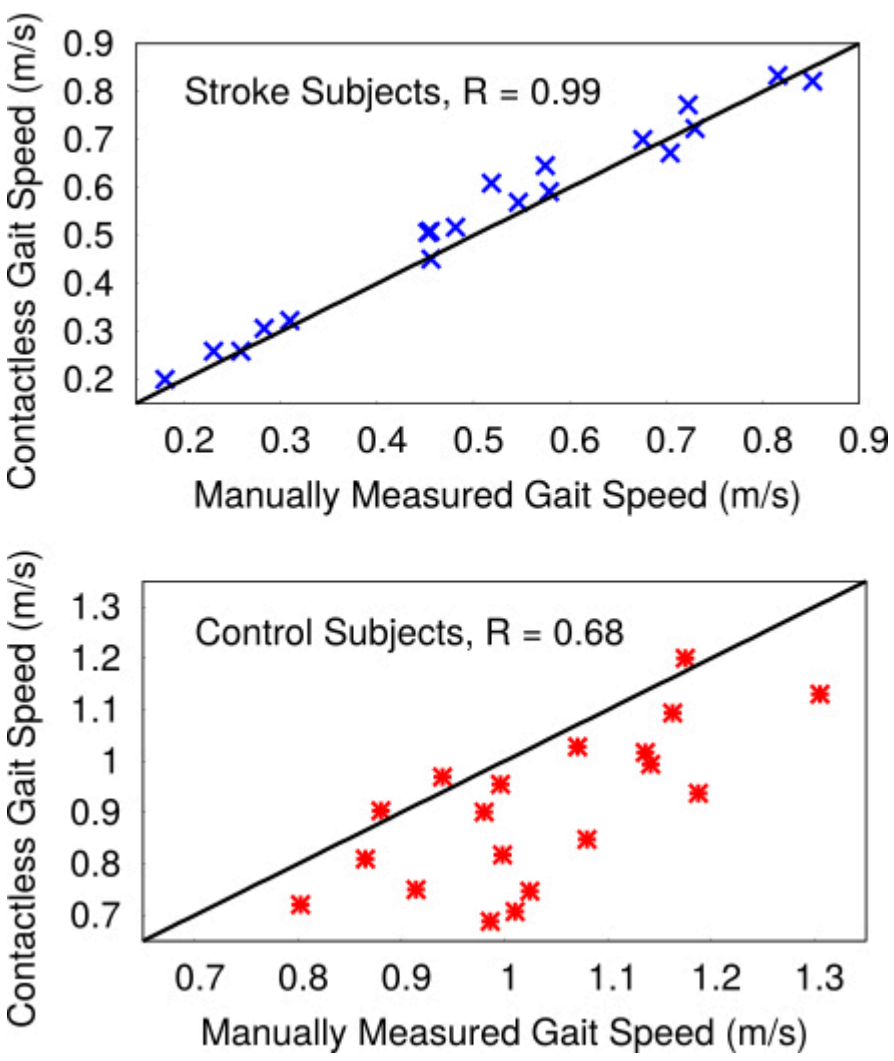
Results: Ten stroke survivors (mean age 62.4 years, standard deviation or SD = 11.8) with self-selected gait speeds of 0.18 to 0.85 m/s and ten control subjects (mean age 31.6 years, SD = 17.7) with gait speeds of 0.80 to 1.31 m/s were evaluated. For stroke survivors, the sensor showed a high correlation (R = 0.99) with manual gait speed measurements, with error mean and SD of 0.03 and 0.02 m/s. For control subjects, the correlation was moderate (R = 0.68), with error mean and SD of 0.14 and 0.10 m/s. So, the sensor is better suited for automatic estimation of low to moderate gait speeds (0.18 m/s to 0.85 m/s). In FM assessments, the sensor accurately estimated lower-extremity action duration with mean errors of 0.60 s and 0.53 s for stroke survivors and controls. Upper-extremity action duration estimates were less accurate than the lower-extremity, but the errors are still less than 2.21 s and 1.89 s for stroke survivors and controls.

Conclusions: In conclusion, the contactless sensor demonstrated high accuracy in estimating gait speed and showed promising results in estimating the duration of lower- and upper-extremity actions in FM assessments for stroke survivors. This technology could facilitate personalized recovery monitoring

in variable environments, including home/health care facilities, potentially triggering rehabilitation needs to improve patient outcomes.



GAIT SPEED:



FUGL-MEYER:

Lower-Extremity Actions

1: Left Leg Up-Down Forward
2: Right Leg Up-Down Forward
3: Left Leg Up-Down Backward
4: Right Leg Up-Down Backward
5: Left Leg Shin-on-Heel
6: Right Leg Shin-on-Heel

Upper-Extremity Actions

7: Answering Telephone with Right Hand
8: Answering Telephone with Left Hand
9: Reverse Answering Telephone with Right Hand
10: Reverse Answering Telephone with Left Hand