

GAIT ANALYSIS USING ULTRASOUND AND INERTIAL SENSORS

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ABSTRACT

Introduction and past research: Inertial sensors are great for orientation estimation, but they cannot measure relative positions of human body segments directly. In previous work we used ultrasound to estimate distances between body segments [1]. In [2] we presented an easy to use system for gait analysis in clinical practice but also in-home situations. Ultrasound range estimates were fused with data from foot-mounted inertial sensors, using an extended Kalman filter, for 3D (relative) position and orientation estimation of the feet.

Validation: From estimated 3D positions we calculated step lengths and stride widths and compared this to an optical reference system for validation. Mean (\pm standard deviation) of absolute differences was 1.7 cm (\pm 1.8 cm) for step lengths and 1.2 cm (\pm 1.2 cm) for stride widths when comparing 54 walking trials of three healthy subjects.

Clinical application: Next, the system presented in [2] was used in the INTERACTION project, for measuring eight stroke subjects during a 10 m walk test [3]. Step lengths, stride widths and stance and swing times were compared with the Berg balance scale score. The first results showed a correlation between step lengths and Berg balance scale scores. To draw real conclusions, more patients and also different activities will be investigated next.

Future work: In future work we will extend the system with inertial sensors on the upper- and lower legs and the pelvis, to be able to calculate a closed loop and improve the estimation of joint angles compared with systems containing only inertial sensors.

REFERENCES

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