

Aim

Determination of gait events (viz., mid swing (MS), foot flat (FF), toe off (TO) and heel strike (HS)) is essential for clinical gait analysis, especially for patients with neuromuscular disorders. Combinations of devices (e.g., VICON and foot plates) are typically used to receive kinematic information. They are, however, usually expensive, time-consuming and cumbersome to use. In current study, the use of Nintendo Wii for detecting the gait events was investigated as a low-cost and easy-to-use alternative.

Methods

Two Wii remotes with Wii Motion Plus were wrapped on both tibias of three healthy subjects. When the subjects walked on a flat surface, the devices would read 3-axis linear accelerations and 3-axis angular velocities. The MS event was determined from finding the local minima of the angular velocity. TO and HS events were then determined from mathematical equations of an average gait cycle period, calculated using autocorrelation of the angular velocity.

$$HS_i = \text{First peak in } \{x | x_{MS_i} < x < (x_{MS_i} + \frac{c_{avg}}{3})\}$$

$$TO_i = \max\{x | (x_{MS_i} - \frac{c_{avg}}{3}) < x < x_{MS_i}\}$$

where i is i^{th} gait cycle

c_{avg} is an average gait cycle period.

The FF event was located at the middle of the consecutive TO and HS events, where we could verify that the sum of the 3-axis accelerations was 1 g in magnitude.

Result

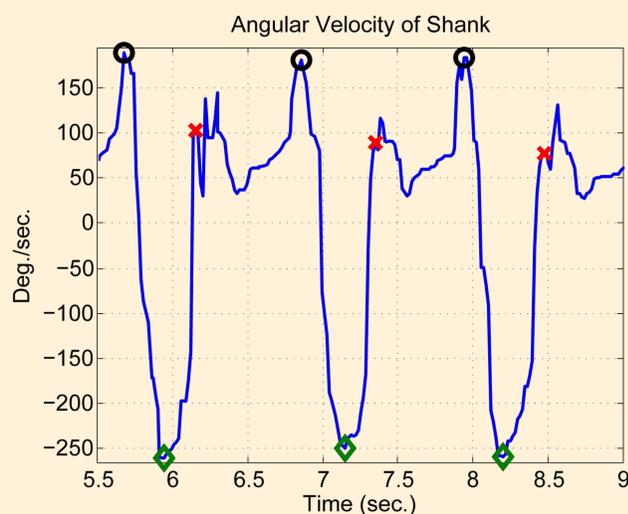


Figure 1: Detection of MS(\diamond), TO(\circ) and HS(\times) events

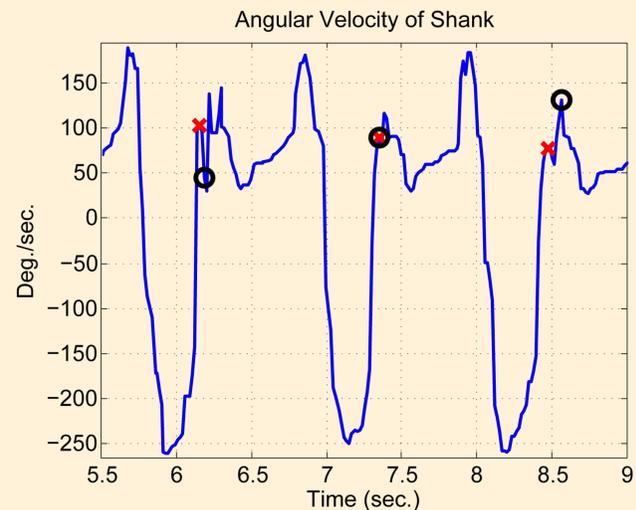


Figure 2: HS event determined from gyroscope(\times) and accelerometer(\circ)

	Duration (sec.)	SD	CoV (%)
Left	1.136	0.0217	1.9104
Right	1.161	0.0558	4.8066

Table 1: Variation of the stride time.

The HS events determined from both the angular velocity and the linear acceleration were in good agreement (coefficient of variation of the stride time was within 5% deviation).

Conclusion

The study demonstrates that it is possible to use Nintendo Wii remotes for gait event detection.

Acknowledgements

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References

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