G.A.I.T. : GAIT ANALYSIS INTERACTIVE TOOL, A PIPELINE FOR AUTOMATIC DETECTION OF GAIT EVENTS ACROSS NEUROMOTOR DISORDERS

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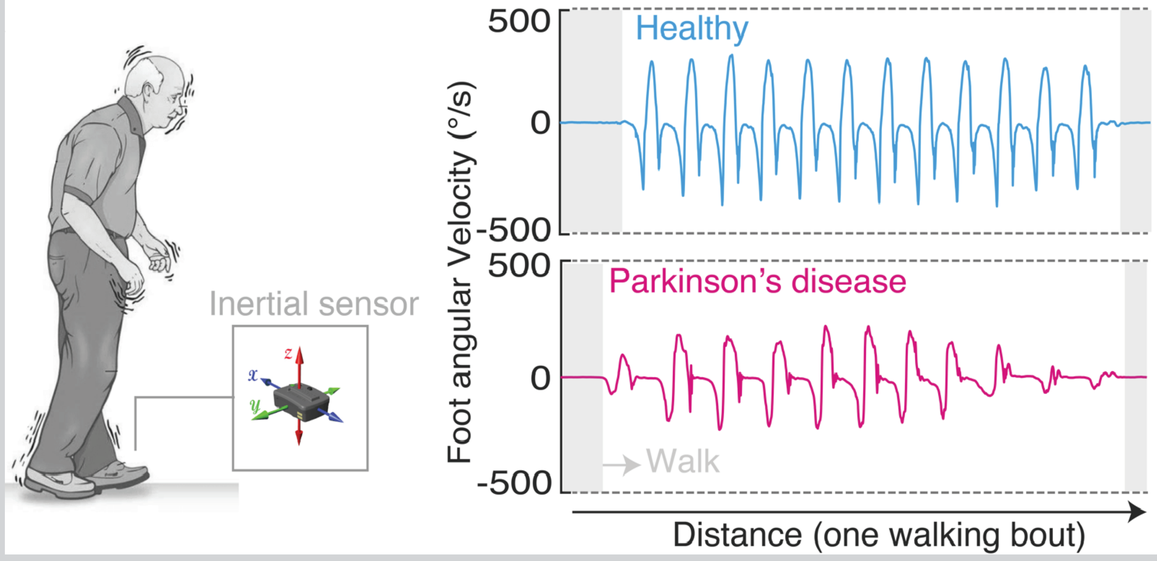
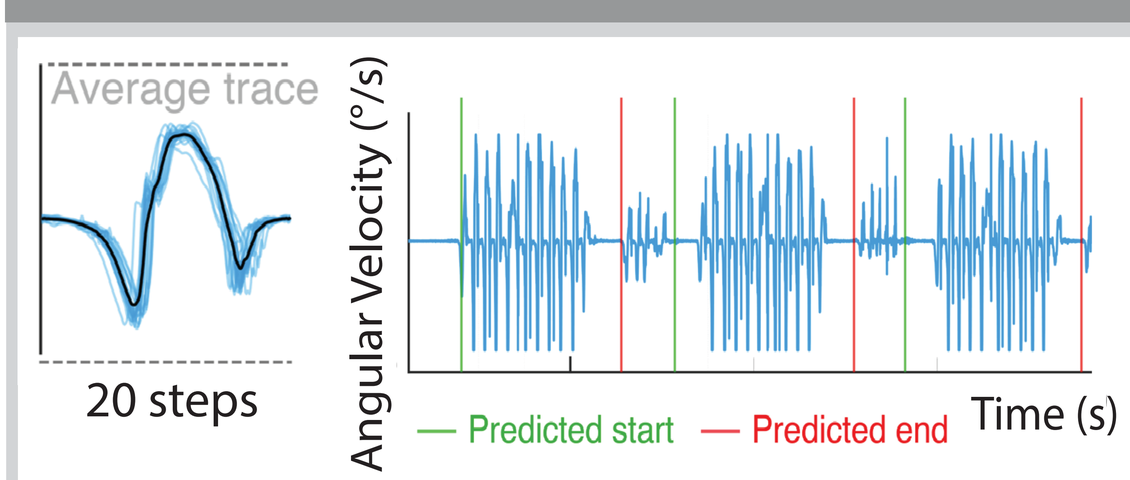
HIGHLIGHTS

We present an automated tool for extracting gait event timing during locomotion in individuals with motor disorders. The tool utilizes inertial sensors placed on the feet and has been validated on individuals exhibiting both normal and pathological kinematic patterns.

1. **Gait segmentation:** to recognize and isolate the walking task, we use a pattern computed by averaging the signal of a gait cycle gathered from a healthy subject. The tool recognizes the different portions of the walking task inside the whole gait task and presents them to the user.
2. **Detection of the main events:** automatic detection is achived by identifying the broad peak that characterizes the swing phase and it corresponds to the complete detachment of the foot from the ground between the toe off (TO) and the heel strike (HS).
3. **Results:** the algorithm was validated on normal weight and overweight or obese patients and tested on fourteen patients affected by Parkinson's desease.

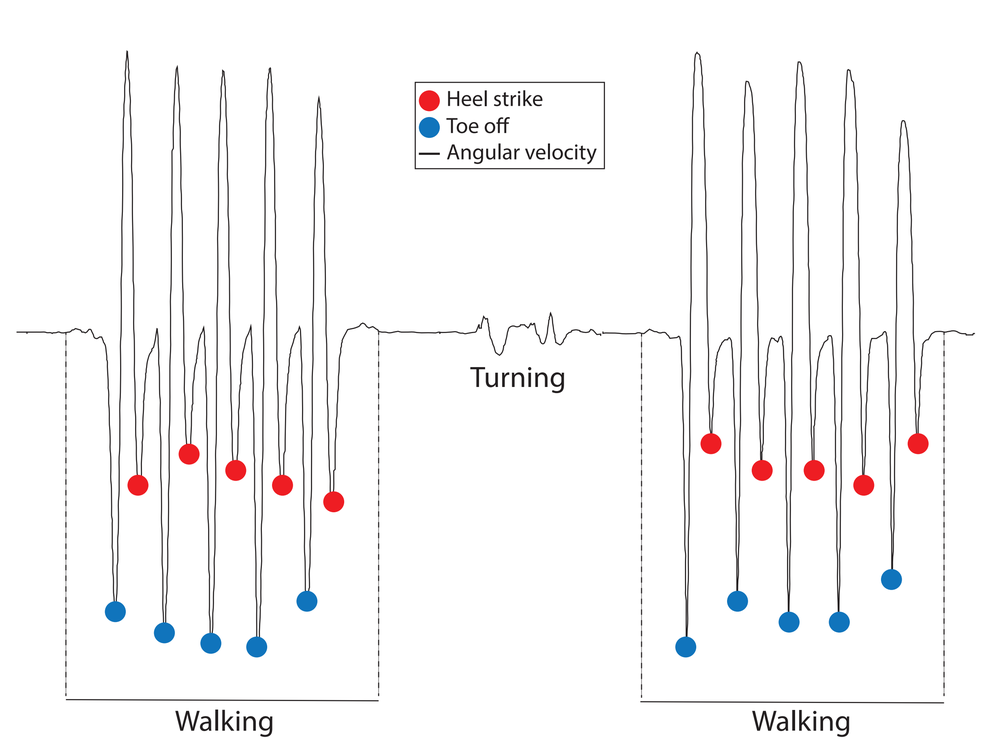


1 GAIT SEGMENTATION



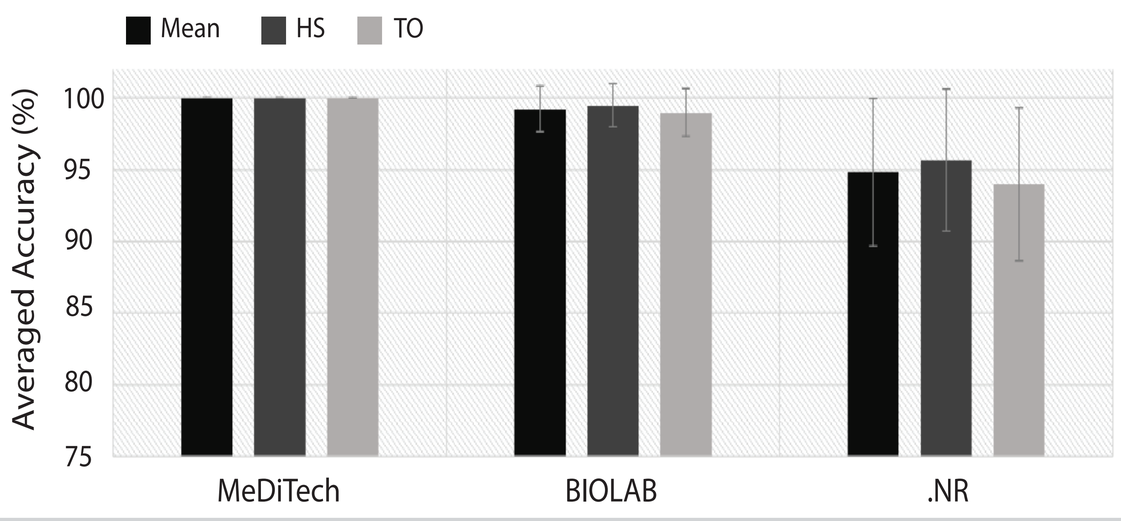
Due to the confined spaces in which signals are usually recorded or the need to remain within ranges of the acquisition system, several changes in direction occur during gait that often consist of the alternating of walking and pauses followed by rotations.

2 DETECTION OF THE MAIN EVENTS



The algorithm estracts the succession of toe off and heel strike events during walking by analyzing the angular velocity recorded by the gyroscope around the mid-lateral axis.

3 RESULTS



The algorithm was tested on a control group and validated using a further database that includes IMUs data along with footswitch data (BIOLAB) that identifies all gait events with precise timing. Finally, it was tested on patients with Parkinson's disease.

CONCLUSION

Results demonstrate that the algorithm accurately detects all relevant gait events based solely on the gyroscope signal from the mid-lateral axes of the ankle joint. In summary, the tool's impact lies in its user-friendly interface, open-access availability, and the simplicity of the measurement setup, requiring only a single gyroscopic signal per foot.

Future works may include testing the pipeline on other motor tasks such as overcoming obstacles, climbing stairs, walking uphill or downhill, or walking at different speeds.

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