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USING ACCELERATION SENSORS TO IDENTIFY RIGIDITY RELEASE THRESHOLD DURING DEEP BRAIN STIMULATION SURGERY

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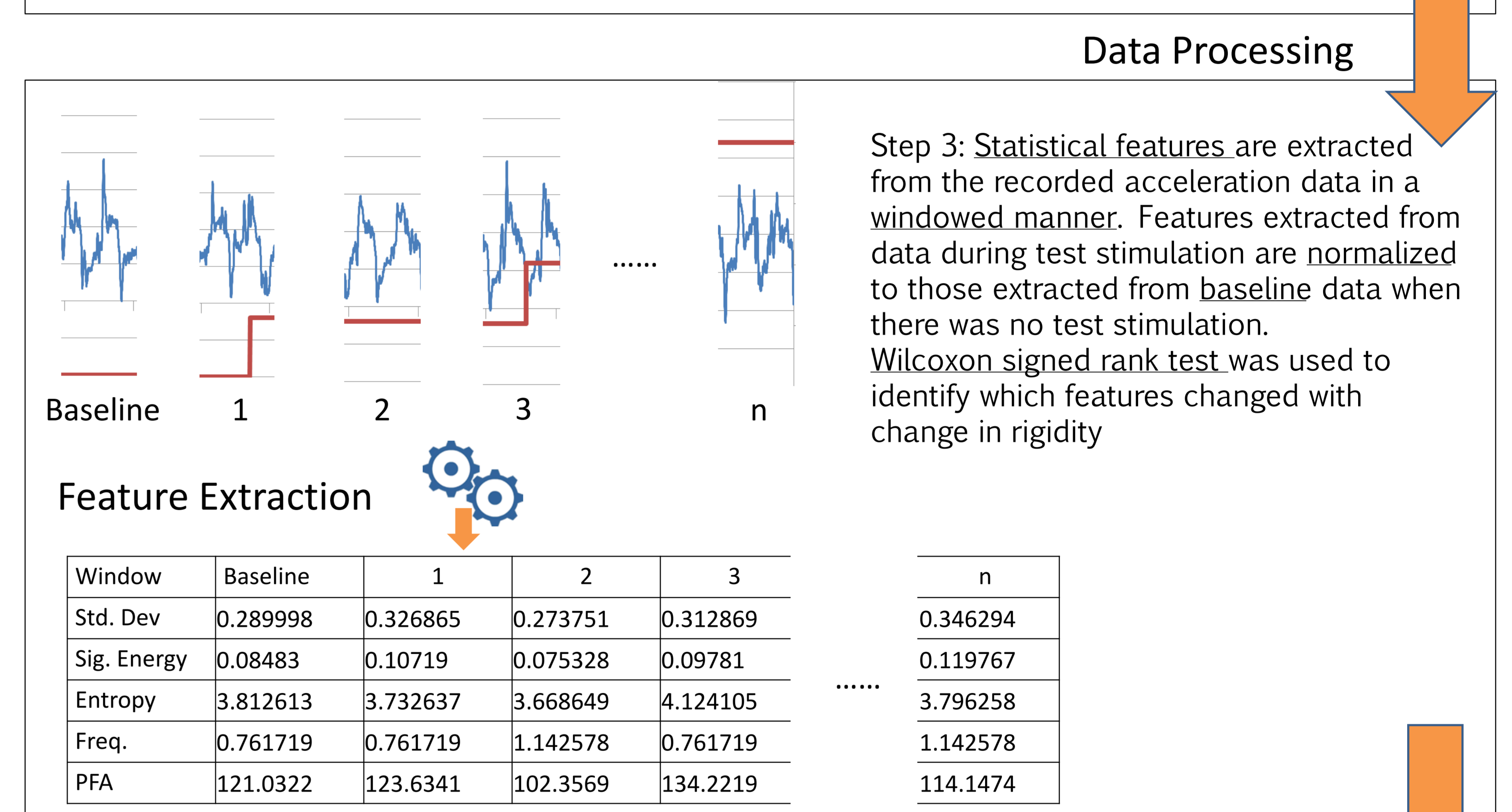
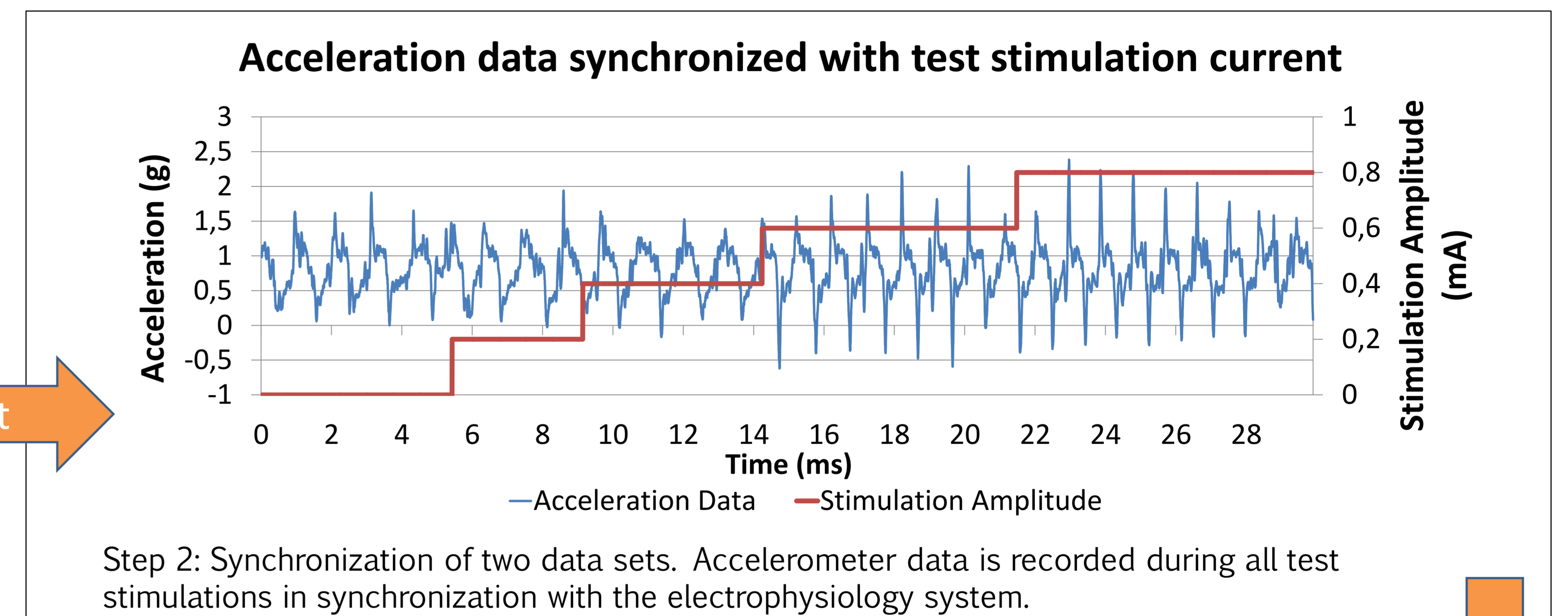
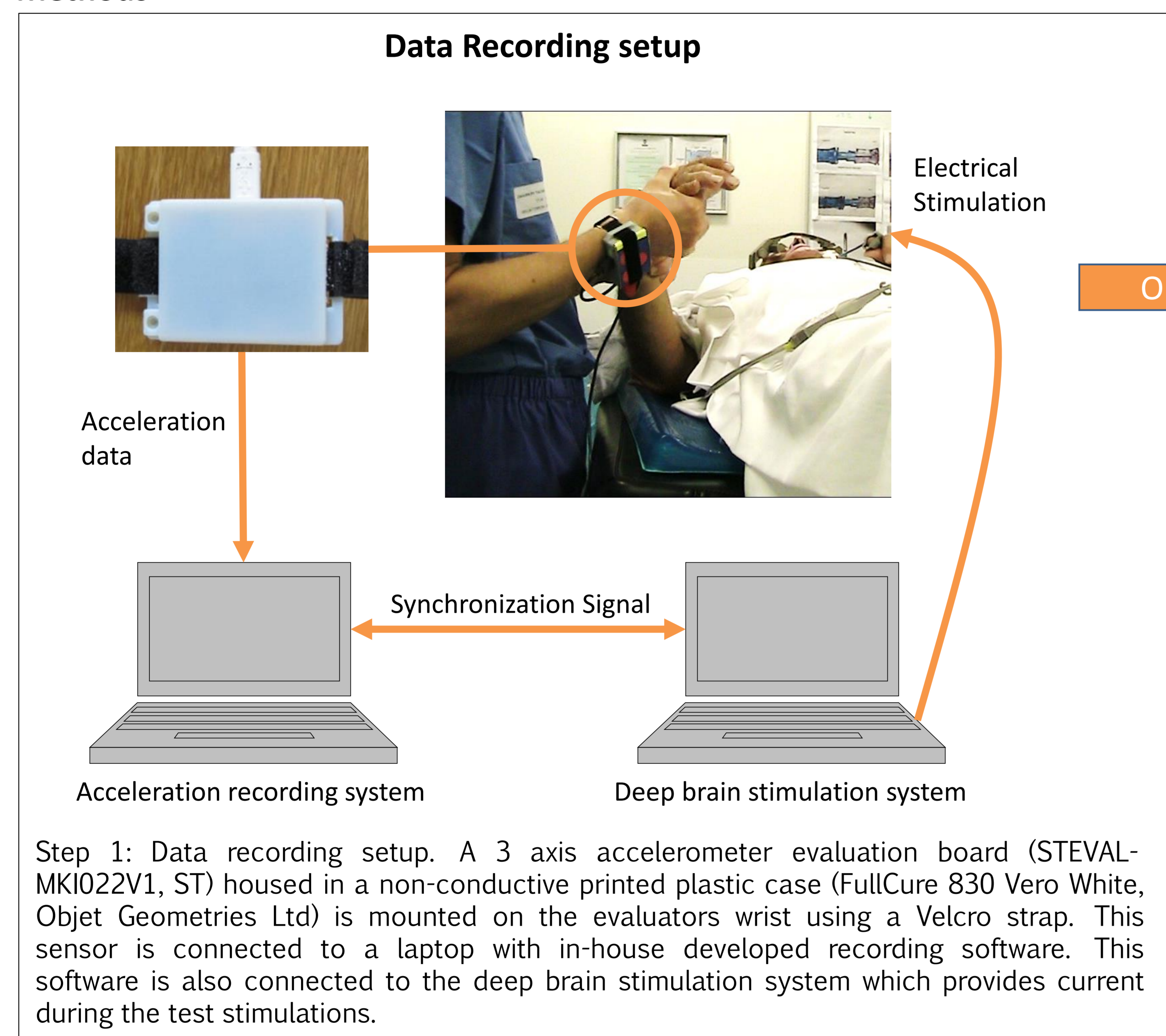
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Background

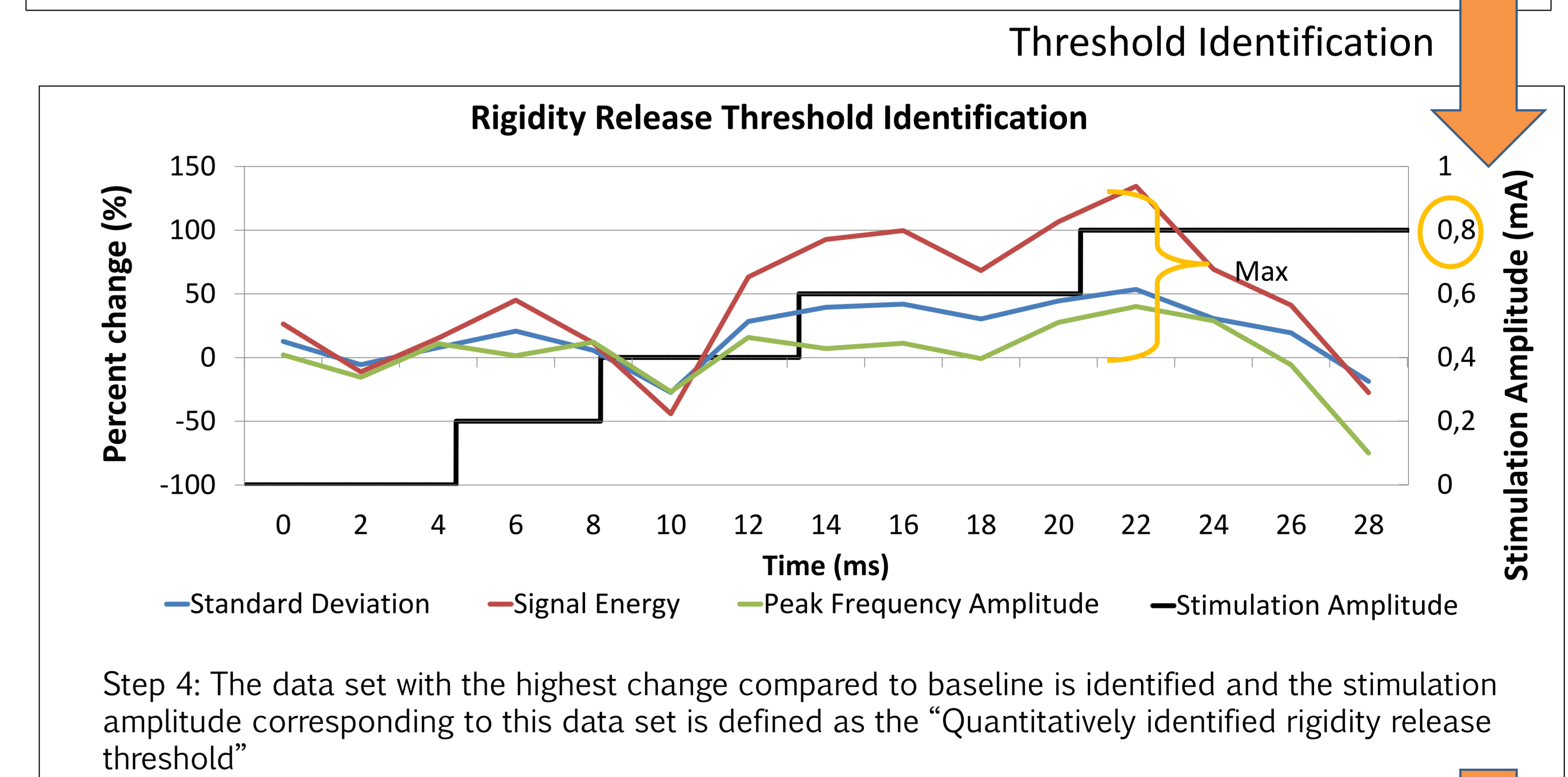
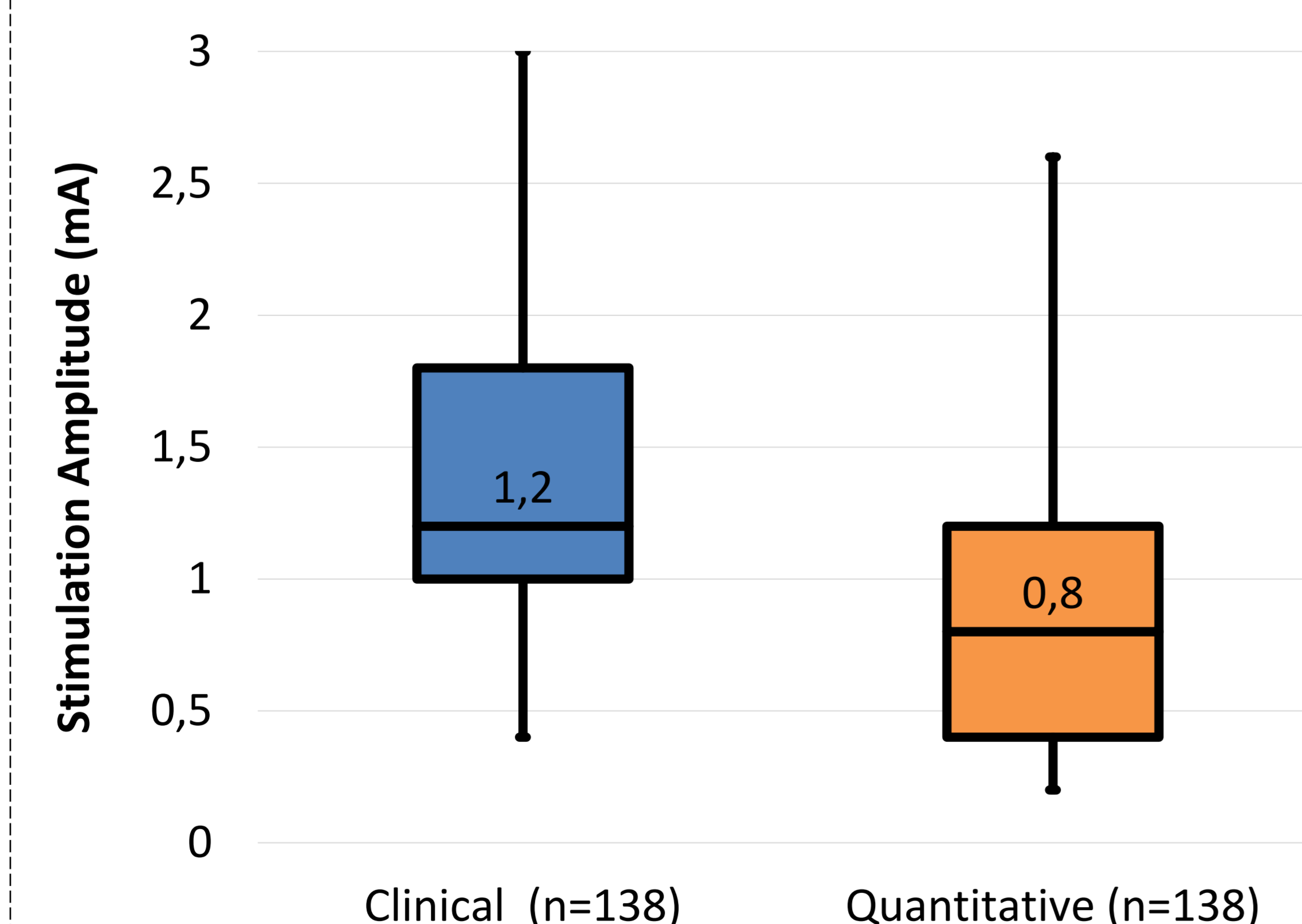
Deep brain stimulation (DBS) is now a widely accepted surgical treatment for Parkinson's disease (PD). Electrodes are implanted in the patient's brain after intraoperative test stimulation. Changes in parkinsonian rigidity during test stimulation are detected by an evaluator, usually a neurologist, by identifying changes in the resistance of the patient's arm to a passive movement. When a stimulation-induced reduction in rigidity is observed, the stimulation amplitude is noted; this is the clinical rigidity release threshold. The aim of the present study was to test the hypothesis that, at the moment of reduction in rigidity, the speed with which the evaluator moves the patient's arms increases, and that this change and its amplitude can be detected with an acceleration sensor.

Methods



Results

- Three statistical features were identified to well describe rigidity release (Standard Deviation, Signal Energy and Spectral Amplitude of the Peak Frequency)
- Out of the 190 test stimulations, rigidity release thresholds were found using the clinical method for 144 evaluations, while using quantitative method, 160 thresholds were found. For 138 test stimulations, thresholds were found using both the methods.
- The rigidity release thresholds found using accelerometer evaluation are significantly lower than those found clinically (Fig 5).



Clinical Application

- Clinical study carried out in University Hospital Clermont-Ferrand, France.
- Data was recorded from 9 PD patients who underwent DBS surgery
- A total of 190 test stimulations were performed and data analysed following steps 1 to 4.

Conclusion

- The acceleration of the neurologist's movement is inversely proportional to change in patient's rigidity.
- Acceleration measurements confirm the subjective evaluation, but they seem to be more sensitive (Fig 5).
- Quantitative rigidity evaluation is feasible during DBS surgery.

Acknowledgements

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Discussion

- The additional acceleration measurements during the surgery did not increase operation time or the patient's discomfort.
- Sufficient baseline data is necessary for proper identification of acceleration thresholds.
- There is an inherent subjective component in the acceleration analysis because the evaluation is done by the neurologist.
- Further analysis in relation to anatomy could result in better target structures and could raise additional knowledge of the mechanisms of action of DBS

