



HAL
open science

Using acceleration sensors to identify rigidity release threshold during Deep Brain Stimulation surgery

Ashesh Shah, Jerome Coste, Jean-Jacques Lemaire, Erik Schkommodau, Raphael Guzman, Ethan Taub, Simone Hemm-Ode

► **To cite this version:**

Ashesh Shah, Jerome Coste, Jean-Jacques Lemaire, Erik Schkommodau, Raphael Guzman, et al.. Using acceleration sensors to identify rigidity release threshold during Deep Brain Stimulation surgery. 7th international IEEE EMBS Conference on Neural Engineering, Apr 2015, Montpellier, France. poster 520, 2015, IEEE/EMBS Conference on Neural Engineering (NER), 2015. hal-01866559

HAL Id: hal-01866559

<https://uca.hal.science/hal-01866559v1>

Submitted on 19 Sep 2018

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

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

A. Shah¹, Member, IEEE, J. Coste², JJ. Lemaire², E. Schkommodau¹, Member, IEEE, R. Guzman³, E. Taub³ and S. Hemm-Ode¹, Member, IEEE

¹Institute for Medical and Analytical Technologies, University of Applied Sciences and Arts Northwestern Switzerland, School of Life Sciences, Muttenz, Switzerland

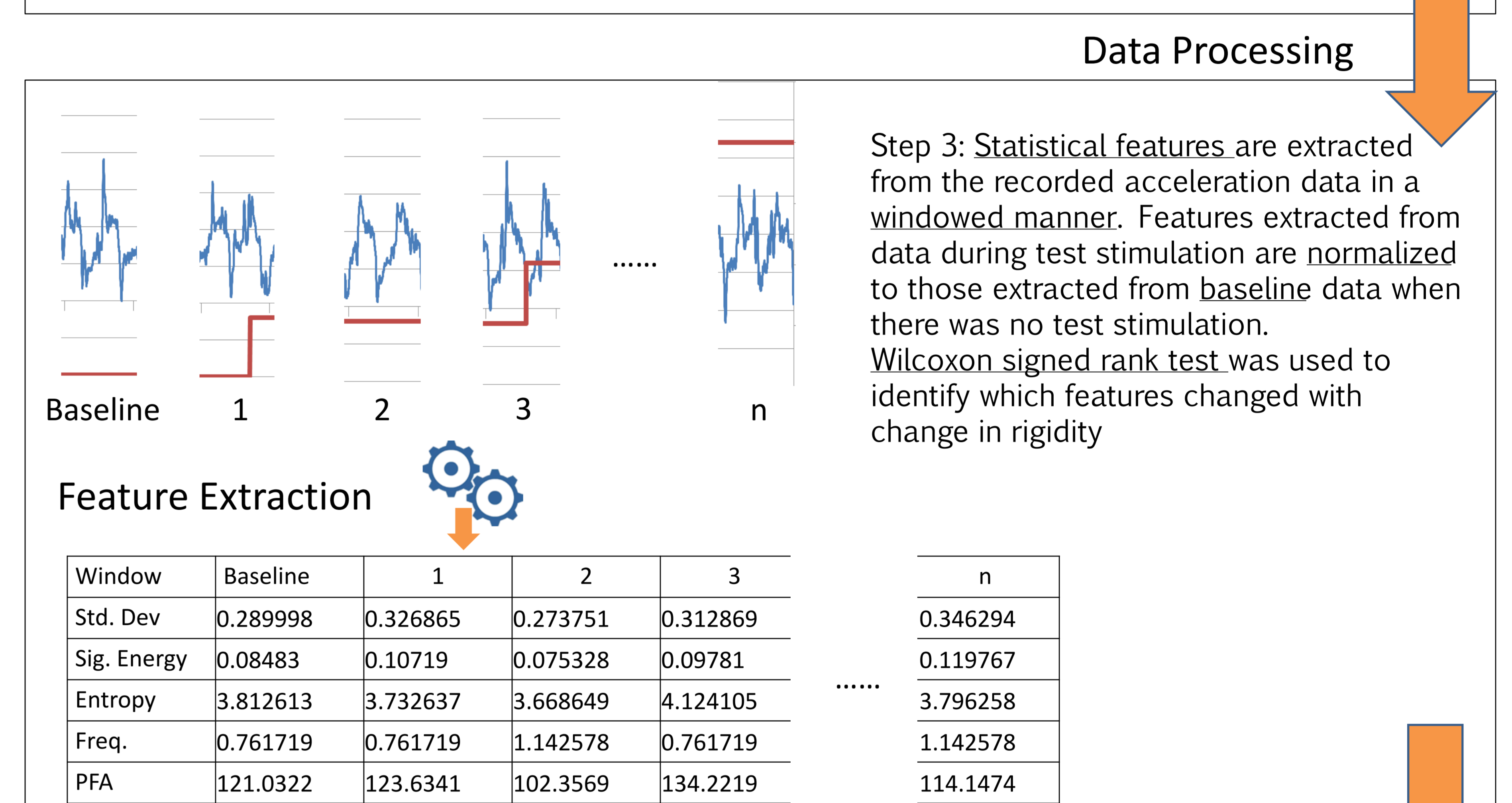
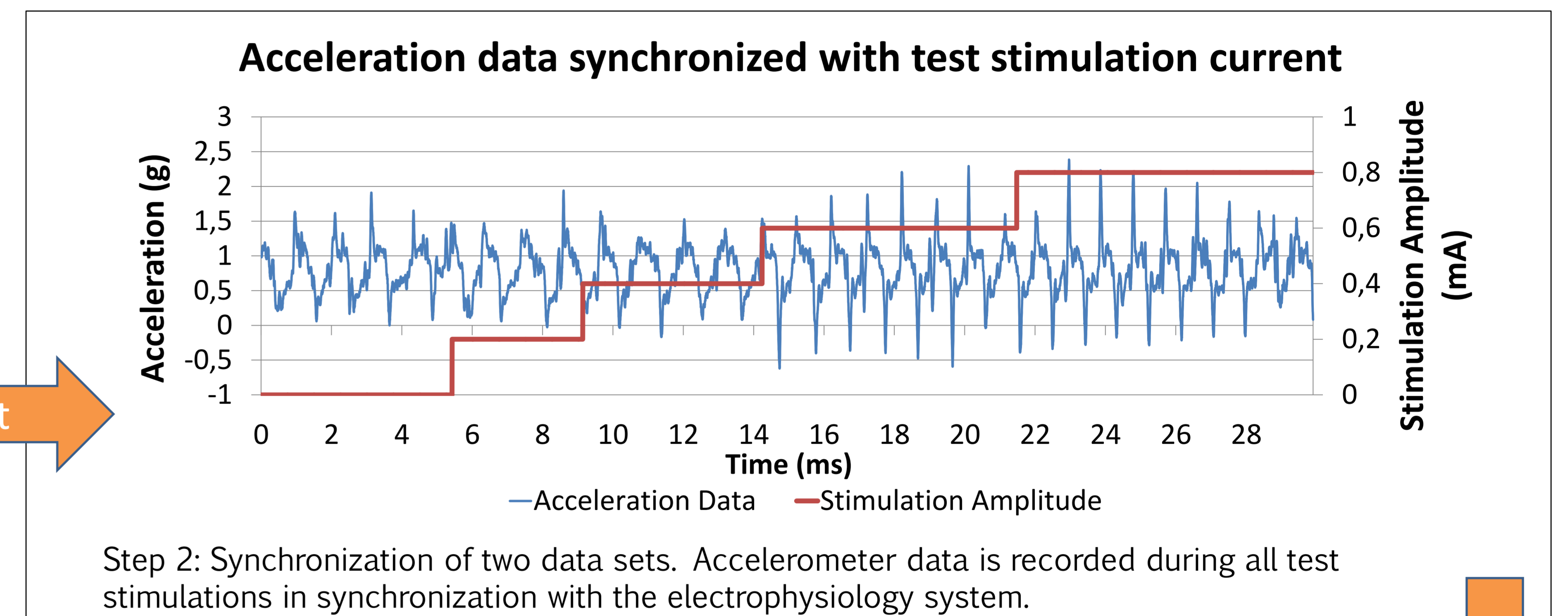
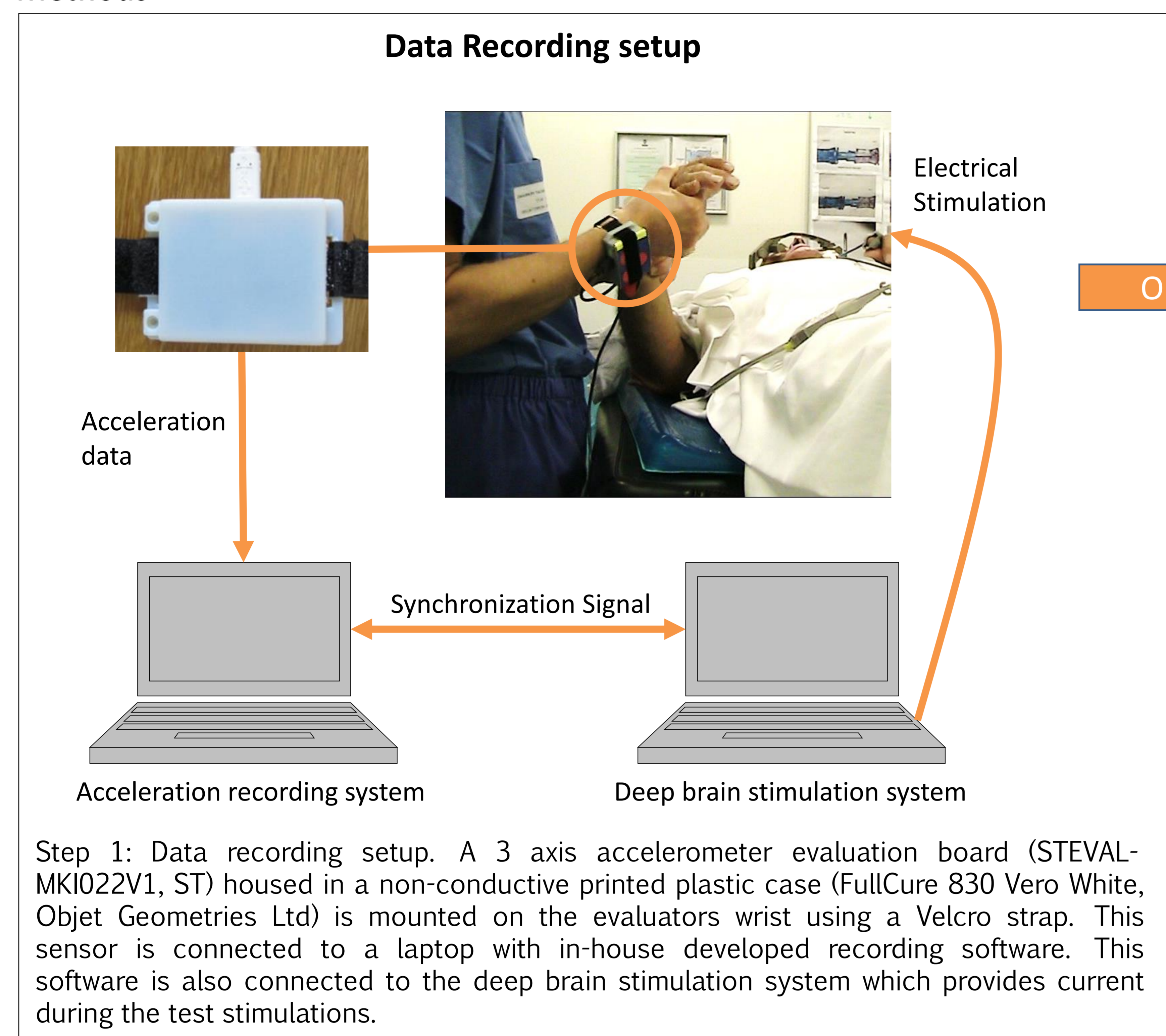
²CHU de Clermont-Ferrand, EA 7282, IGCNC, Université d'Auvergne, France, CHU de Clermont-Ferrand, France

³Departments of Neurosurgery and Biomedicine, University Hospital Basel, Basel, Switzerland

Background

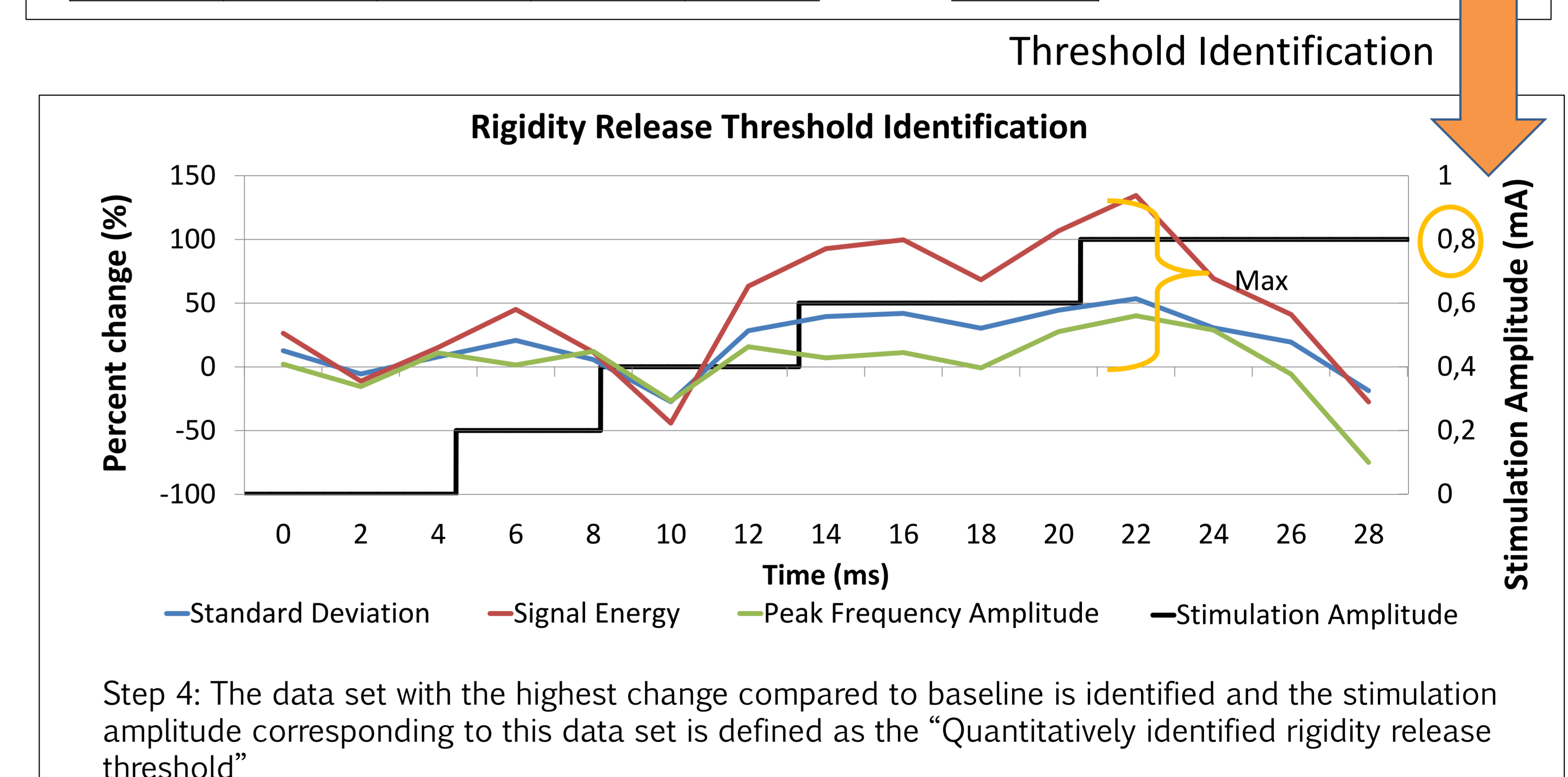
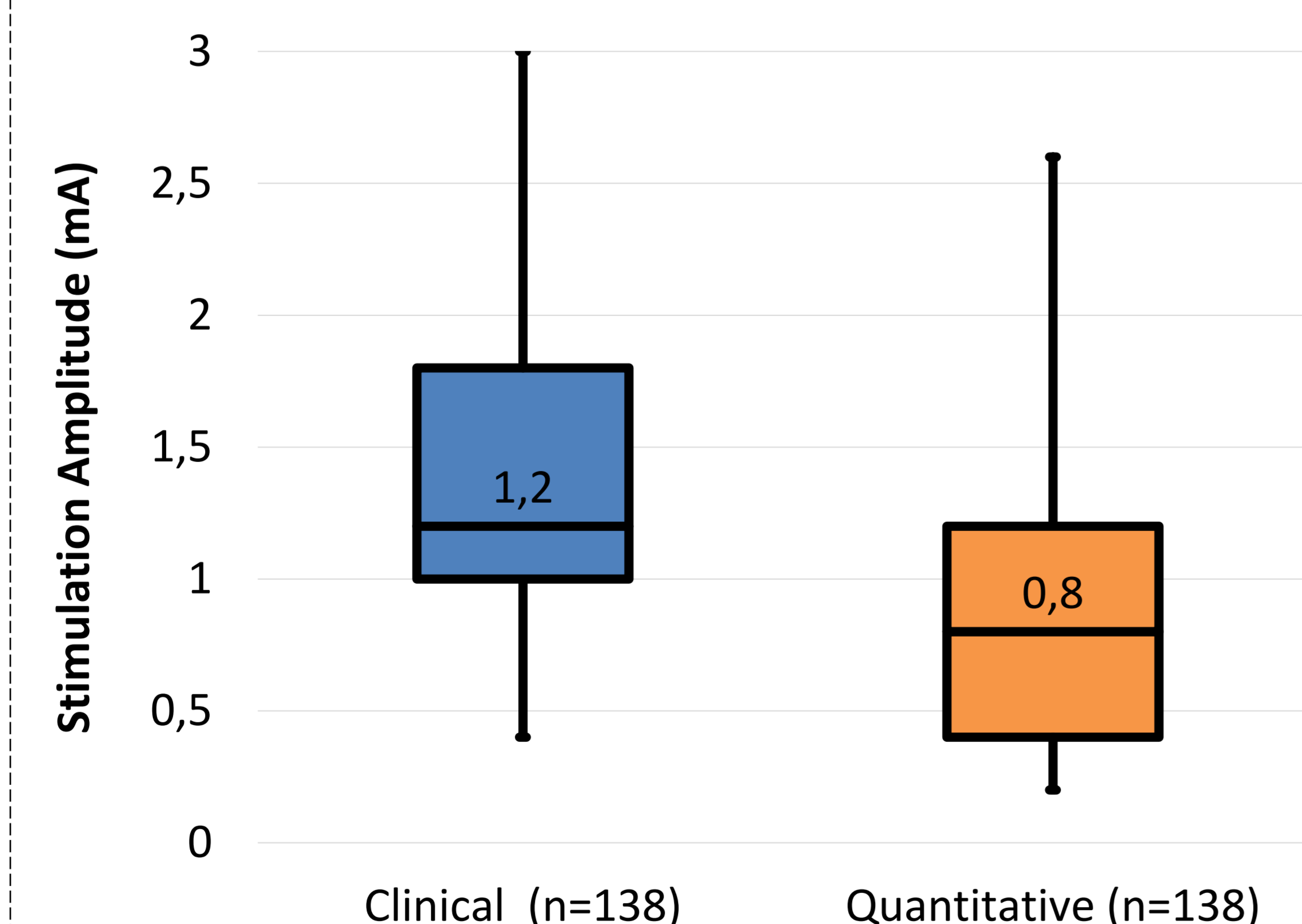
Deep brain stimulation (DBS) is now a widely accepted surgical treatment for Parkinson's disease (PD). Electrodes are implanted in the patient's brain after intraoperative test stimulation. Changes in parkinsonian rigidity during test stimulation are detected by an evaluator, usually a neurologist, by 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

This research has been supported by the Swiss National Science Foundation (SNSF) and the Germaine de Stael program.

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

