

# **SIMULTANEOUS TRACKING OF MULTIPLE NOCICEPTIVE THRESHOLDS: A SIMULATION AND HUMAN SUBJECT STUDY**

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## **ABSTRACT**

Nociceptive thresholds show dynamic changes during noxious events such as disease, clinical intervention or experimental perturbations. Estimation of thresholds is relevant for early detection of nociceptive related diseases (e.g. hyperalgesia). However, these thresholds are momentary recordings and therefore do not reveal dynamic behavior. In addition, different stimulus parameters result in different thresholds [1]. Simultaneous estimation of multiple *psychophysical* thresholds, each with different stimulus parameters, might provide *more* information about the momentary state of the nociceptive system. Tracking of multiple thresholds before, during and after a noxious event can reveal dynamics in the nociceptive system. This information of nociceptive dynamics might be relevant for early detection of nociceptive diseases (e.g. post-operative chronic pain).

In a previous study, we showed the feasibility of tracking a threshold over time [2]. However, no information is available on how many thresholds can be simultaneously tracked without losing significant information about the dynamics within the nociceptive system. This study aims to compare bias, precision and bandwidth of tracked thresholds.

Monte Carlo simulations were performed to compare bias, precision and bandwidth of threshold estimates while varying the number of simultaneous tracked thresholds (1-7). An adaptive random staircase procedure was used as stimulus selection procedure while logistic regression was used to obtain threshold estimates. We found that the bias was similar in all simulations. Moreover, precision and bandwidth lowered with more simultaneous tracked thresholds.

Three different numbers of simultaneous tracked thresholds were compared in a human subject study. A cold pressor was applied as nociceptive conditioning stimulus. Electrocutaneous stimulation was used for nociceptive detection threshold tracking before, during and after the conditioning stimulus. With the obtained results, we are able to make a trade-off between estimation precision and bandwidth and the number of simultaneous tracked thresholds.

With the findings of this study, we are able to perform experiments where multiple thresholds can be tracked in healthy subjects leading to better characterization of the nociceptive system. Eventually, simultaneously tracking multiple nociceptive thresholds might be useful in clinical environments (e.g. pre-operative detection of post-operative chronic pain development).

## **REFERENCES**

- [1] E.M. van der Heide, J.R. Buitenweg, E. Marani, W.L.C. Rutten, "Single pulse and train modulation of cutaneous electrical stimulation: a comparison of methods," J Clin Neurophysiol, vol. 26, pp. 54-60, Feb 2009
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