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

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Backgrounds

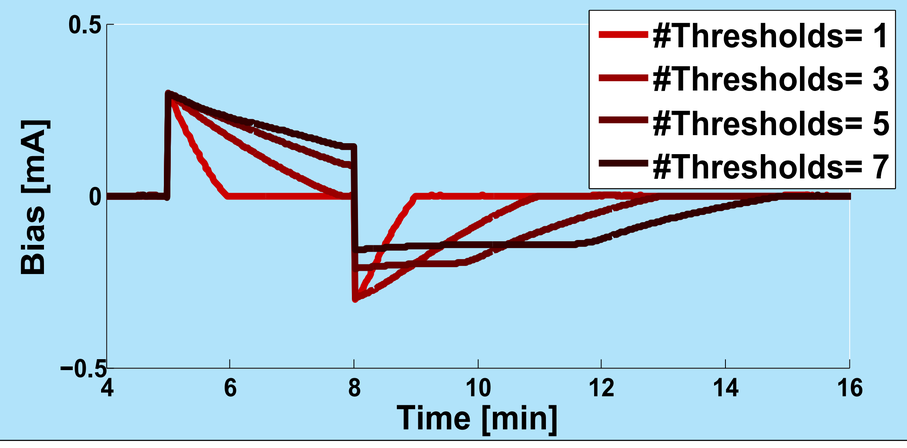
Tracking of nociceptive thresholds before, during and after a nociceptive perturbation allows us to obtain information about the dynamics of the nociceptive system. Moreover, tracking multiple thresholds, each threshold as a response to different stimulus parameters (i.e. pulse-width, number of pulses and inter puls interval), might help us to identify nociceptive malfunctioning in both ascending and descending pathways.

Problem & strategy

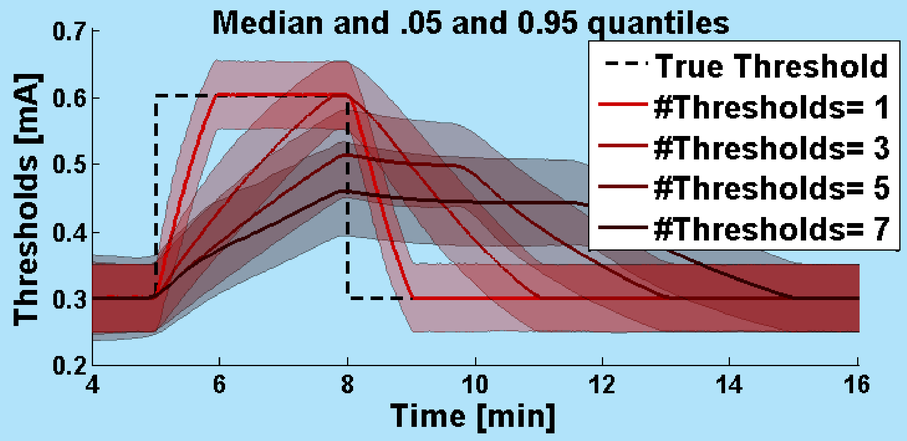
In a previous study, we showed the feasibility of tracking a threshold over time [1]. However, no information is available on how many thresholds can be simultaneously tracked without losing significant information about the dynamics within the nociceptive system. Monte Carlo simulations are used to compare bias, precision and bandwidth of tracked thresholds and a human subject study is used to validate simulation results.

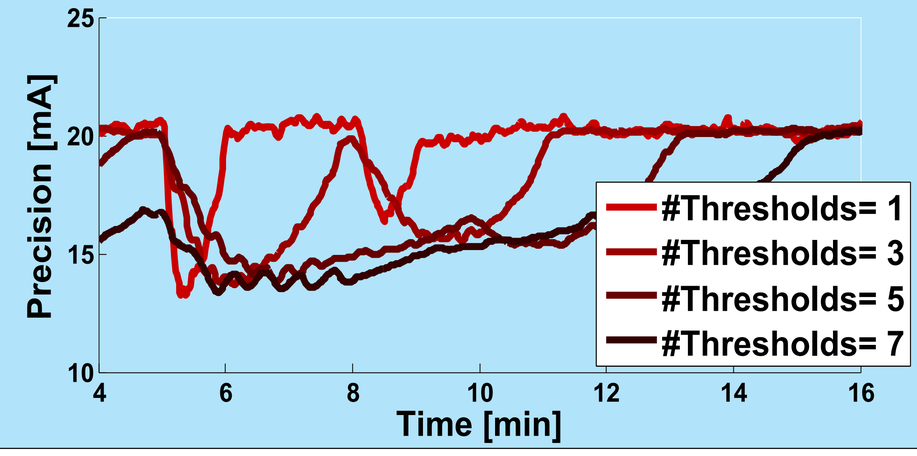
Simulations: methods

Monte Carlo simulations were performed to compare bias, precision and bandwidth of threshold estimates while varying the number of simultaneous tracked thresholds (max 7). An adaptive random staircase procedure was used for stimulus selection. Logistic regression was used to obtain threshold estimates. The true threshold varied over time. The bias was defined as the difference between true threshold and estimated threshold. Precision was defined as the difference between median and .95 quantile.



Simulations: results





Human subject study: methods

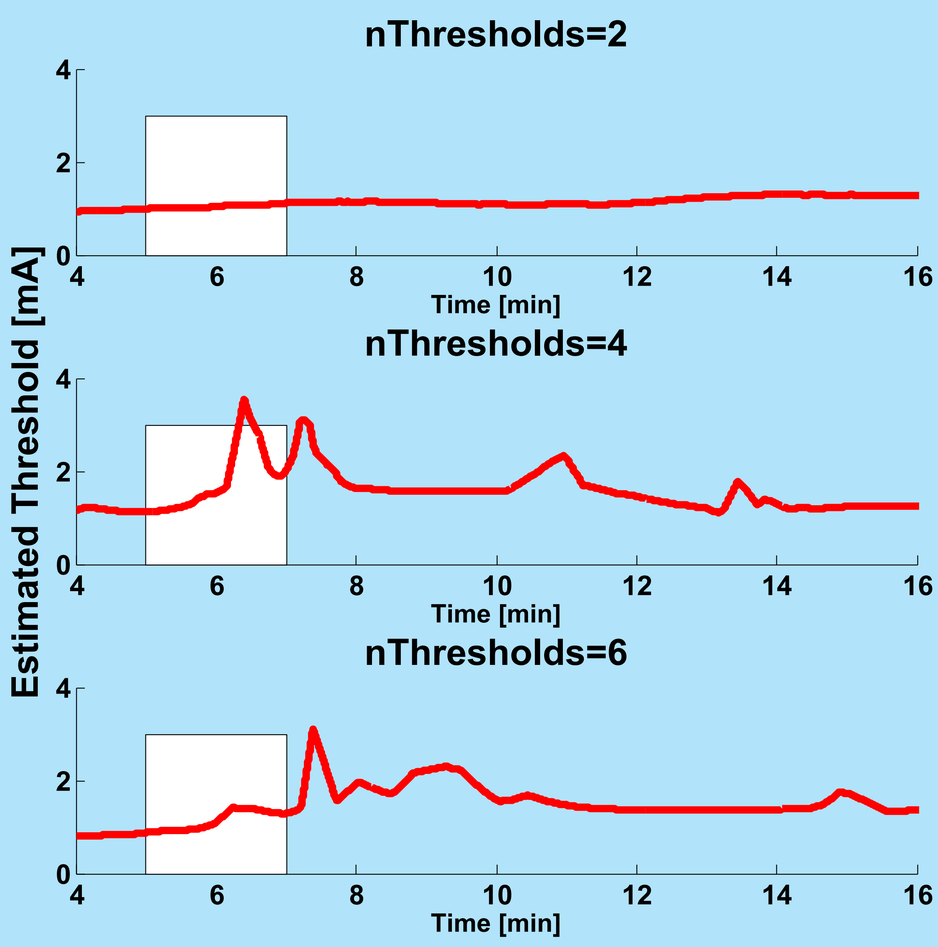
Three different numbers of simultaneous tracked thresholds were compared in a small preliminary psychophysical study (N=6). A two minute cold pressor test was applied as nociceptive conditioning stimulus (e.g. [2]). Electrocutaneous stimulation [3] was used for nociceptive detection threshold tracking before, during and after the conditioning stimulus. The local ethics committee approved all experiment procedures and consent was obtained from all subjects.

Discussion

We performed simulations to find the effect of tracking multiple thresholds on bias, precision and bandwidth of estimated thresholds. Lowest bias highest precision during changing thresholds is achieved when as few as possible thresholds are tracked. Tracking more thresholds results in an increase in bias and decrease in precision.

A preliminary human subject study was performed to validate simulation results. Due to the limited number of included human subjects, no conclusions can be drawn yet. However, it is expected that the findings of the human subject study will be similar to those found in the simulations.

Human subject study: results



References

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[2] Pud, D., Granovsky, Y. et al. (2009). Pain

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