

Introduction

Nociceptive thresholds show dynamic changes during noxious events (e.g. clinical interference, disease, or experimental perturbations) [1].

Continuously estimating (i.e. tracking) psychophysical nociceptive thresholds before, during, and after a nociceptive conditioning stimulus might therefore contribute to the knowledge in mechanisms involved in both ascending and descending pathways of the nociceptive system.

Various stimulus selection procedures have been proposed for estimation of static, but not dynamic, thresholds [2].

The aim of this study is to analyse various existing adaptive psychophysical stimulus selection procedures and a new procedure based on stochastic stimulus selection for the use in human nociceptive threshold tracking experiments.

Methods

A staircase, PSI [3], ascending and two stochastic stimulus selection procedures were compared in two simulation models. The first to determine bias, precision and efficiency for a static threshold, the second to determine bias for a dynamic threshold.

The static model simulates a static experiment (i.e. the threshold remains fixed). All mentioned stimulus selection procedures are used to estimate the true threshold for each trial (i.e. given stimuli).

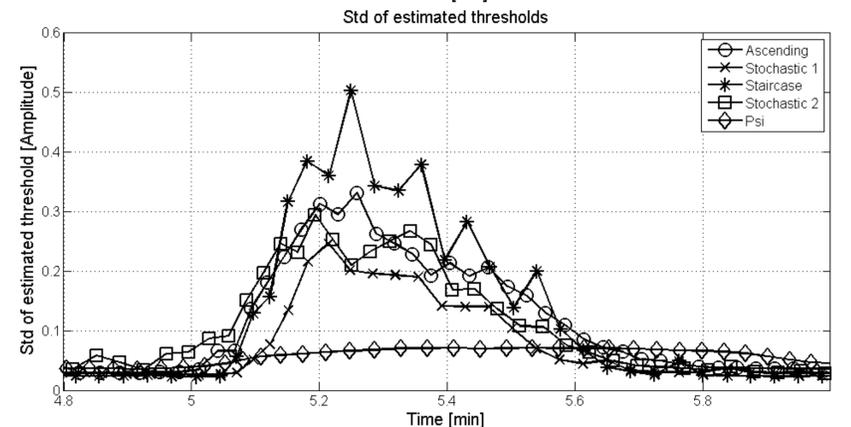
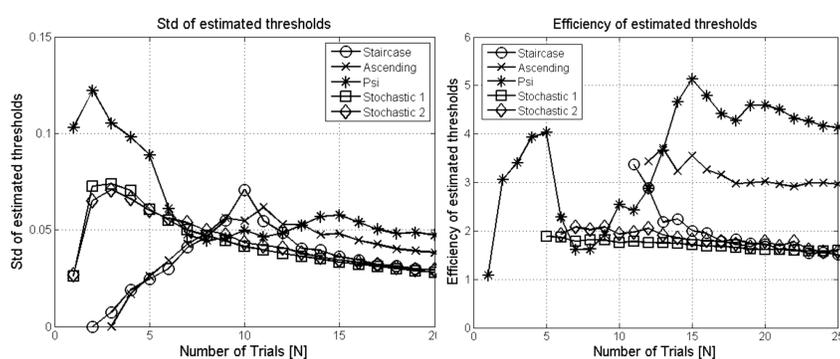
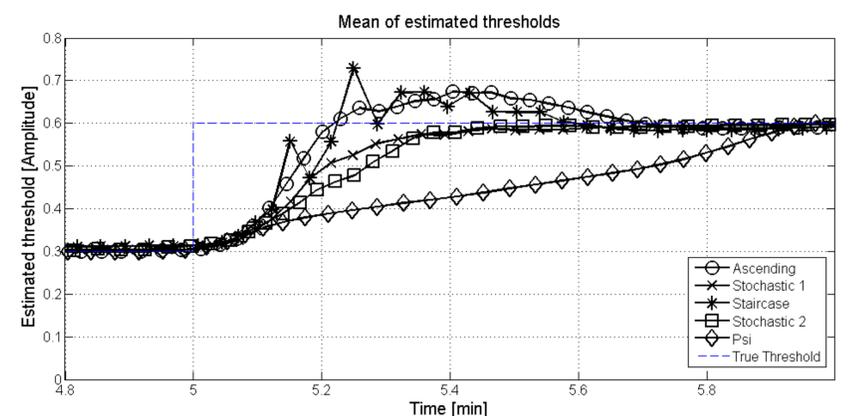
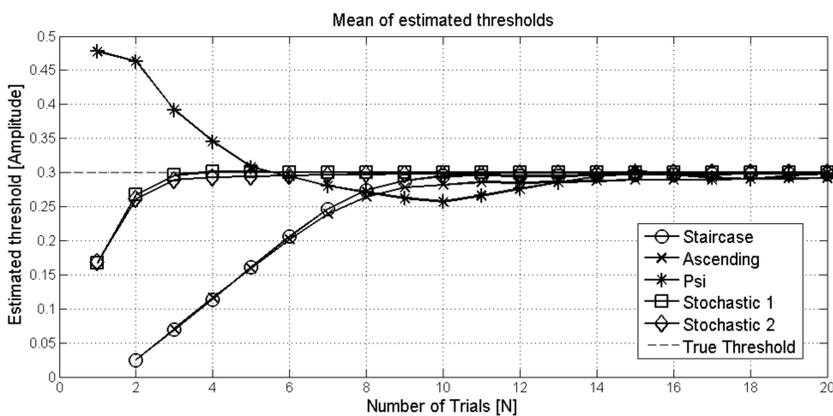
The dynamic model simulates a 15 minute lasting experiment with a threshold change between the fifth and tenth minutes.

The static model is run 5.000 times per stimulus selection procedure, whereas the dynamic models is run 1.000 times per stimulus selection procedure.

Results

All stimulus selection procedures were compared in terms of bias, precision and efficiency. For each procedure, multiple settings are simulated. The mean, std and efficiency of all static runs with the best performing settings per procedure are shown in the figures below.

For each stimulus selection procedure, one set of settings were used in the dynamic simulation model. Estimations are made with N previous trials. Mean and std of dynamic results between the 4.8th and 6th minutes are shown in the figures below.



Discussion and conclusions

In terms of low bias, high efficiency (i.e. a low value for the efficiency) and fast responds to dynamic changes with a minimum amount of trials, it was found that the stochastic 1 method performs best.

A new adaptive psychophysical stimulus selection procedure based on stochastic stimulus selection is proposed as a nociceptive threshold tracking procedure.

References

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- [2] B. Treutwein, "Adaptive psychophysical procedures," *Vision Res*, vol. 35, pp. 2503-22, Sep 1995.
- [3] L. L. Kontsevich and C. W. Tyler, "Bayesian adaptive estimation of psychometric slope and threshold," *Vision Research*, vol. 39, pp. 2729-2737, 1999.

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