IDENTIFICATION OF THE NOCICEPTIVE FORWARD PATHWAY USING AMPLITUDE-RESPONSE PAIRS

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ABSTRACT

Malfunctioning of the nociceptive forward pathway plays a key role in the development of chronic pain, which reduces the quality of lives of the patients. To quantitatively characterize the nociceptive forward pathway, four neurophysiological parameters can be estimated by integrating computational models and multiple perception thresholds [1]. This model-based approach could reveal the state of the nociceptive malfunctioning for understanding the development of pain, e.g. central sensitization. With suitable psychophysical procedures [2], one can obtain amplitude-response pairs around a perception threshold. Combining these techniques, one can first perform logistic regression to obtain a threshold from amplitude-response pairs and use that for parameter estimation [1].

In this work, we directly estimate parameters using the amplitude-response pairs without intermediate transformations. We study how the number of trials included influences the estimation and compare with the earlier approach. Furthermore, considering the clinical aspect, whether the pairs using fewer combinations of the temporal settings can still enough to estimate the parameters will be addressed. This work will only consider the simulated dataset to estimate the parameters, which is an essential step to further investigations with real datasets.

The estimate of the system parameters using amplitude-response pairs directly converges faster than the estimate based on the perception threshold. Such improvement of estimation could provide more reliable information for further interpretations of the state of the nociceptive system.

REFERENCES

[1] Yang, H and Buitenweg, J.R. and Meijer, H.G.E. (2012) Identification of the nociceptive forward pathway using perception thresholds. In: 8th IFAC Symposium on Biological and Medical Systems, 29-31 Aug 2012, Budapest, Hungary. pp. 367-372.

[2] Doll, R.J. and Yang, H and Meijer, H.G.E. and Buitenweg, J.R. (2011) Simulation of psychophysical stimulus selection procedures for dynamic threshold tracking. In: Tenth Belgian Day on Biomedical Engineering, 2 Dec 2011, Brussels, Belgium. pp. 39-39.