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Bayesian decoding of neural spike trains

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Abstract Perception, memory, learning, and decision making are processes carried out in the brain. The performance of such intelligent tasks is made possible by the communication of neurons through sequences of voltage pulses called spike trains. It is of great interest to have methods of extracting information from spike trains in order to learn about their relationship to behavior. In this article, we review a Bayesian approach to this problem based on state-space representations of point processes. We discuss some of the theory and we describe the way these methods are used in decoding

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motor cortical activity, in which the hand motion is reconstructed from neural spike trains.

Keywords Point process · State-space model · Recursive Bayesian filter · Sequential Gaussian approximation · Neural decoding