BISP8

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Particle Learning Approach to Bayesian Model Selection: An Application from Neurology

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Our aim is to estimate the number of motor units (MUs) within a patient’s muscle via a non-invasive experimentation. Each MU may, or not, activate in reaction to a given electrical stimulus, but the probability increases according to the stimuli’s intensity. The total action potential from the activated MUs is recorded for all applied stimuli. The analysis is complicated by the occurrence of ‘alternation’, where different MU combinations activate under identical conditions. The current method uses simplistic assumptions and substantially overestimates the number of MUs.

We have developed a state-space representation of the MU number estimation model where an indicator vector denotes the combined MU response to any given stimuli. The historical MU firing events are integrated into the model through the use of updatable sufficient statistics. A particle learning algorithm is applied separately for each considered number of MUs in order to evaluate an estimate of the marginal likelihood, thereby enabling the calculation of the required posterior probability density.

Simulation studies for small neuromuscular systems, containing 3-10 MUs, are very promising. In order to analyse larger systems we must overcome the exponential growth in computation that is caused by the model size and the length of the study.

Keywords:
Bayesian Model Selection; Particle Learning; Motor Unit Number Estimation.

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