

BAYESIAN INFERENCE OF THE SURVIVING NUMBER OF MOTOR NEURONS FOR MOTOR NEURON DISEASE PATIENTS

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This talk describes the challenges of inference for the remaining number of motor neurons for suffers of neurological diseases such as Motor Neuron Disease. In Ridall et al (2006, 2007) we describe a stochastic model for the firing of motor neurons in a muscle of the leg or arm when the muscle nerve is subject to an electrical stimulus. For a series of increasing electrical stimuli to the nerve the neuro-muscular response is measured as a series of electrical currents, giving the so-called the response curve, where the amplitude of the response current is the summation of the output currents of units which are firing as a result of the stimulus. Units can fire probabilistically, or always or never for a given input stimulus. The consequent response can be modelled (in a simplified form) by a so-called mixture of mixtures given by the distribution of $Z_1X_1 + Z_2X_2 + \dots + Z_NX_N$ where the Z are independent Bernoulli random variables with means depending on the applied stimulus and the X are independent normal random variables with differing means not dependent on the stimulus. The main focus is on inference for N , the unknown number of motor units or number of components in the mixture of mixtures. In Ridall et al (2007) we used RJMCMC to make inferences for N . This talk will consider approaches to improve the RJMCMC algorithm, how the RJMCMC output from a sequence of studies on a patient can be used to make inferences about the nature of the underlying mechanism of neuron death and score between mechanisms, and how sequential Monte Carlo for static problems can be utilised to estimate the value of the unknown N .

References

Ridall G, Pettitt AN, Henderson RD and McCombe PA. (2006). Motor unit number estimation, a Bayesian approach. *Biometrics* **62**, 1235-1250.

Ridall PG, Pettitt AN, Friel N, Henderson R and McCombe P. (2007) Motor unit number estimation using reversible jump Markov chain Monte Carlo (with discussion). *Applied Statistics* (Journal Royal Statistical Society Series C) **56**, 235-269.