NETWORK INFERENCE IN A STOCHASTIC MULTI-POPULATION NEURAL MASS MODEL VIA APPROXIMATE BAYESIAN COMPUTATION

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The aim of this talk is to infer the connectivity structures of brain regions before and during epileptic seizure. Our contributions are fourfold. First, we propose a 6N-dimensional stochastic differential equation (SDE) for modelling the activity of N coupled populations of neurons in the brain. This model further develops the (single population) stochastic Jansen and Rit neural mass model, which describes human electroencephalography (EEG) rhythms, in particular signals with epileptic activity. Second, we construct a reliable and efficient numerical scheme for the SDE simulation, extending a splitting procedure proposed for one neural population. Third, we propose an adapted Sequential Monte Carlo Approximate Bayesian Computation algorithm for simulation-based inference of both the relevant real-valued model parameters as well as the {0,1}-valued network parameters, the latter describing the coupling directions among the N modelled neural populations. Fourth, after illustrating and validating the proposed statistical approach on different types of simulated data, we apply it to a set of multi-channel EEG data recorded before and during an epileptic seizure. The real data experiments suggest, for example, a larger activation in each neural population and a stronger connectivity on the left brain hemisphere during seizure.