Bayesian analysis of human movement data using MCMC methods

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We consider the Bayesian analysis of human movement data, where the subjects perform various reaching tasks. A set of markers is placed on each subject and a system of cameras records the three-dimensional Cartesian co-ordinates of the markers during the reaching movement. It is of interest to describe the mean and variability of the curves, and to describe any differences due to covariates. The data have been collected by James Richardson (Université de Paris-Sud).

We propose a hierarchical Bayesian model for the curves. An important part of the model is to obtain identifiable features of the movement so that different curves can be compared after temporal warping. We consider four landmarks and a set of equally spaced pseudo-landmarks are located in between. A conditional multivariate normal model for the curves is proposed and Bayesian analysis is carried out using simulation from the posterior. In particular, Metropolis-Hastings and Gibbs steps are used in the Markov chain Monte Carlo algorithm. We demonstrate that the algorithm works well in locating the landmarks, and shape analysis techniques are used to describe the posterior distribution of the mean curve. A feature of this type of data is that some parts of the movement may be missing - the Bayesian analysis is easily adapted to cope with this situation.