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Modelling Group Dynamic Animal Movement in Continuous Time

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This paper presents a new approach to continuous-time modelling and inference for the collective movement of individuals, for example animals tracked using GPS technology. Each of the n individuals of the group, moving in d dimensions, is attracted to a moving, unobservable leading point. The movement of the leading point follows its own movement model, for example an Ornstein-Uhlenbeck process attracted to an unknown attractor. The movement of the whole system is then represented as a diffusion process in (n + 1)d dimensions. Under simple but realistic assumptions, the whole system can be modelled as a multivariate Ornstein-Uhlenbeck process. In this work, we use Markov chain Monte Carlo sampling to impute the position of the unobserved leading point, and to infer the movement and attraction parameters. This involves Metropolis-Hastings sampling with proposal distributions based on the conditioned movement processes. Some results are shown for the simultaneous tracking of a group of reindeer.

Keywords:
Multivariate Ornstein Uhlenbeck process; OU bridge; Bayesian Inference

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