The correlated velocity continuous time animal movement model: theory, estimation and applications

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Abstract: Most animal movement models are discrete, despite the fact that animal movements take place in continuous space and time, and data on animal movements is often collected irregularly. Continuous movement models resolve many of the problems with scaling, sampling, and interpretation that affect discrete movement models. For example, the correlated velocity movement (CVM) is a continuous-time analogue to the widely used correlated random walk (CRW) defined in terms of two parameters that have direct biological relevance in terms of energetics at small scales and dispersal at the large scales. Compared to the CRW, however, continuous movement parameters are challenging to estimate and not widely used. We present several methods to estimate CVM parameters - from direct calculation to a complete likelihood of the parameters given movement data. Cases cover a range of resolutions, from very high, as in videography, to low, as in much telemetry, and for data that are regularly sampled or irregularly sampled. We illustrate the application of these methods for several terrestrial and aquatic animal movement datasets, introducing an R package (cvm) for obtaining estimates and confidence intervals. Finally, we discuss ways in which the basic model can be extended to incorporate behaviorally structured movements.

References