Smoothing Splines of Apex Predator Movement: Functional modeling strategies for exploring animal behavior and social interactions

Andrew Whetten[1]

[1]University of Wisconsin-Milwaukee

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Abstract

The collection of animal position data via GPS tracking devices has increased in quality and usage in recent years. Animal position and movement, although measured discretely, follows the same principles of kinematic motion, and as such, the process is inherently continuous and differentiable. I demonstrate the functionality and visual elegance of smoothing spline models. I discuss the challenges and benefits of implementing such an approach, and I provide an analysis of movement and social interaction of seven jaguars inhabiting the Taiamã Ecological Station, Pantanal, Brazil. In the analysis, I derive measures for pairwise distance, cooccurence and spatiotemporal associaton between jaguars, borrowing ideas from density estimation and information theory. These measures are feasible as a result of spline model estimation, and they provide a critical tool for a deeper investigation of cooccurence duration, frequency, and localized spatio-temporal relationships between animals.

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