

Scientific Report for Short Term Scientific Mission

Software package for the analysis of uncertain or sparse trajectory data

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Purpose of visit

The purpose of the visit was to complete a software package that enables advanced movement analysis tasks in the R environment for statistical computing. In particular we focus on analysis tasks in the Brownian bridge movement model (BBMM) that go beyond the well-known utilization distribution, such as detecting movement patterns or investigating movement speeds.

We have been developing this package for some time already, but we encountered some problems that impacted the practical usability of the software. During this visit we wanted to address these problems and ensure that the package is easy to use for anyone interested in it.

Description of the main result obtained

We have changed the underlying data format used by the package to be compatible with the *move*¹ package, which has several advantages:

- It is easier to use functionality from both packages together, as there is no conversion required.
- It allows to easily import data sets from Movebank for use with our analysis tools, since this is already implemented in the *move* package.
- For people who are familiar with tools for spatial data analysis in R, this format is more recognizable, as it is based on the well known R classes from the *sp*² and *raster*³ packages. We can also take advantage of the many data manipulation and plotting functions already available for these.

This is a rather large step that requires modifying most of the already implemented functions. We took this major rewrite as an opportunity to make another large change: We allow the one free parameter in the BBMM, the diffusion coefficient, to vary with time. This opens up new possibilities to further improve the predictions made by this method.

We are still working to complete these changes in the software and prepare a new version for release. Even in this incomplete state, we have noted that many tasks have become easier to perform without in-depth knowledge of R or the package. We strive to continue improving the usability even further.

Based on the analysis we have conducted so far, we have identified several usability improvements. In particular, we have identified methods to deal with gaps in the data or

1 <http://computational-ecology.com/main-move.html>

2 <http://rspatial.r-forge.r-project.org/>

3 <http://cran.r-project.org/web/packages/raster/>

to filter out measurements based on certain criteria that make them irrelevant for the analysis task. We also intend to provide additional statistics for a data set. As the package is developed further, these methods will be added, thus further improving usability.

The figures show some examples of analyses that were developed in the context of this project and were created using the software package.

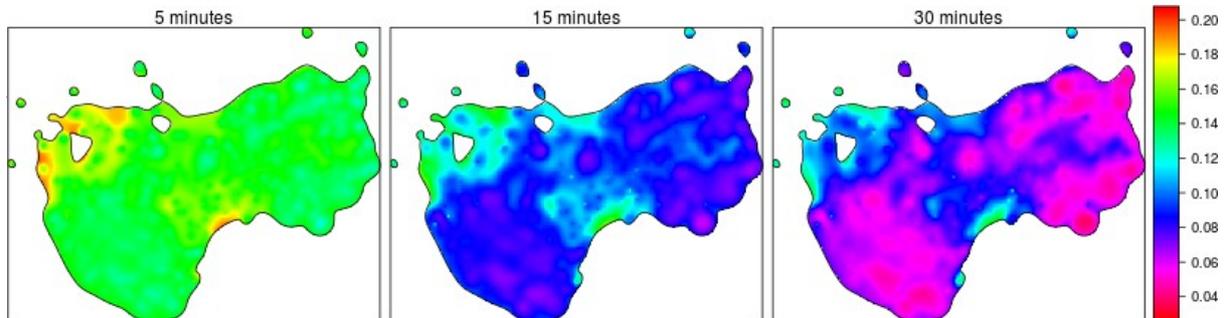


Fig. 1: Spatial distributions of speed for a group of vervet monkeys on different time scales. The results are clipped to the 99% home range. Speed in meters per second.



Fig. 2: Predicted home range for an oystercatcher using the BBMM (left) and the BBMM with a diffusion coefficient that varies based on behaviour (right). The latter is better at predicting intermediate locations than the former.

Future collaboration with host institution

We plan to continue our joint research in developing algorithmic methods for movement ecology. We have shown that the BBMM can be used for more than just computing utilization distributions. The next step is to show that this can lead to new insights into animal behaviour and we are currently conducting studies to show the value of the BBMM.

As new research questions come up, we intend to continue developing algorithmic methods to answer these.

Projected publications/articles resulting or to result from the STSM

We have been using the package in the analysis of movement data from several animals and discovered interesting results regarding movement speeds in relation to other factors. We intend to publish these results and the tools we have used to obtain them shortly.

When we consider the software package ready, we intend to publish it on CRAN, the central repository for R packages, thus allowing anyone to easily install and use it freely.