

# Animal Behaviour Classification

## Using Changepoint Methods

Peter Green

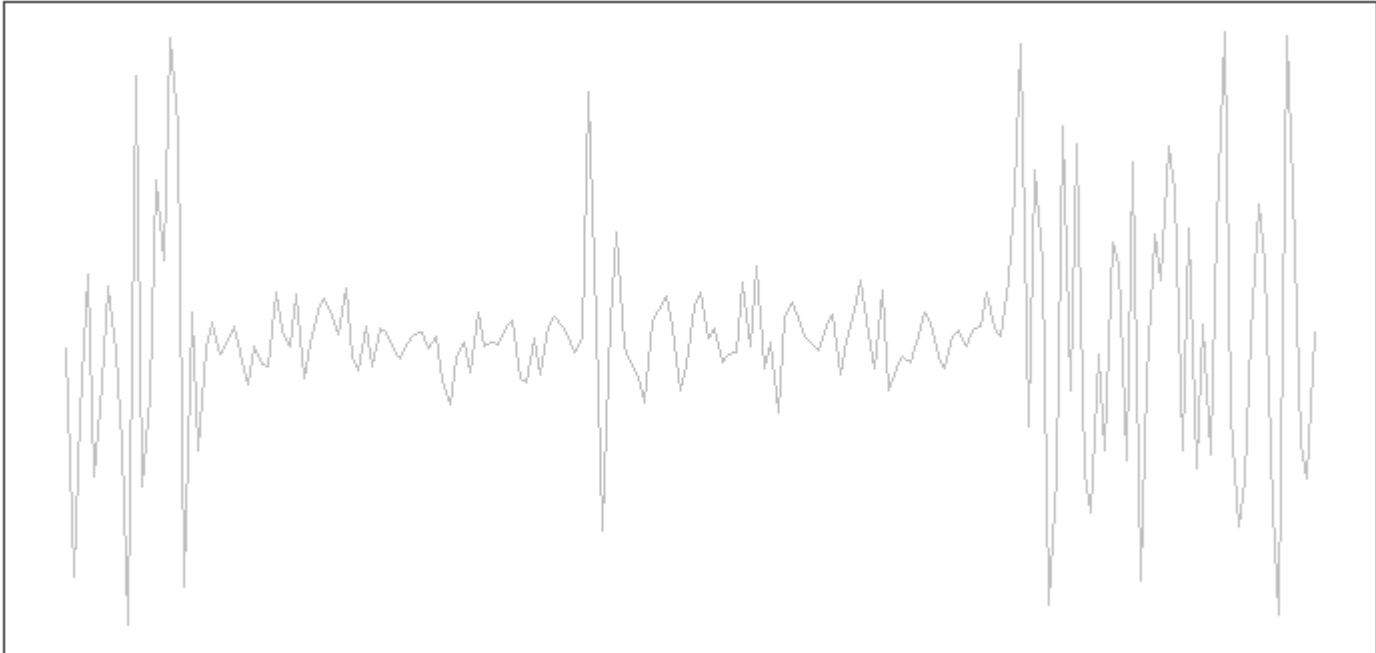
AgResearch (NZ)

2022/12/01

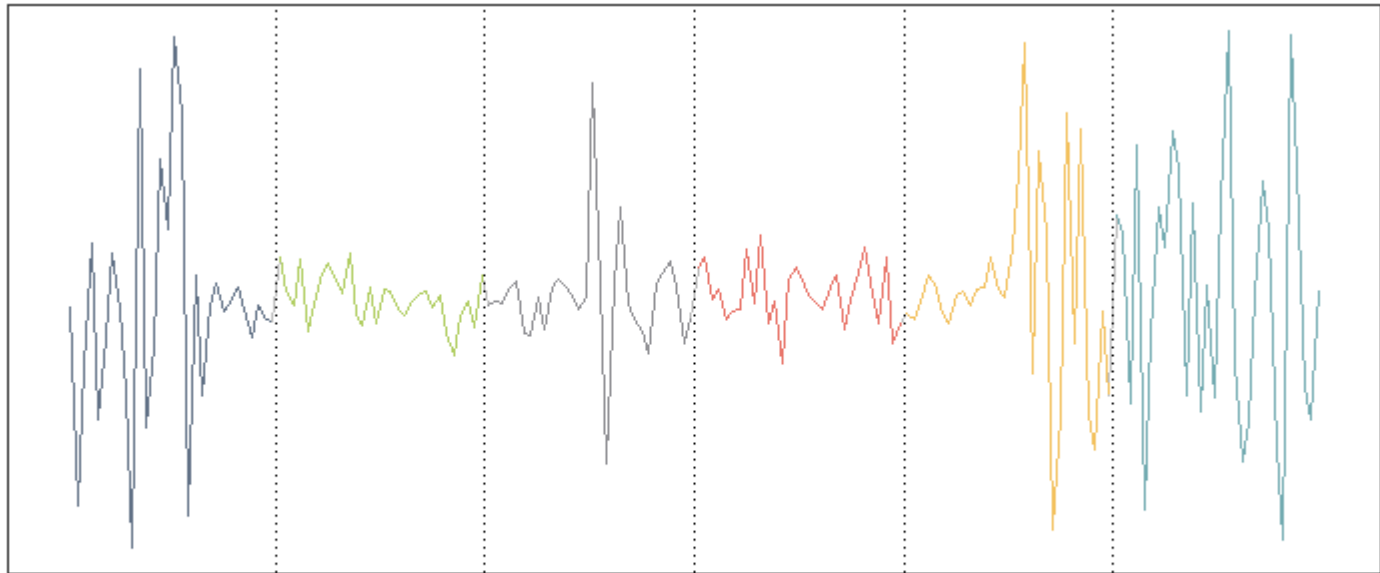
Before I begin, I acknowledge that we meet in the Country of the Bunurong People who are the Traditional Custodians of this land. I pay respect to Elders past and present, and extend my respect to any Aboriginal and Strait Islander peoples present today.



# Take a series of sensor readings...

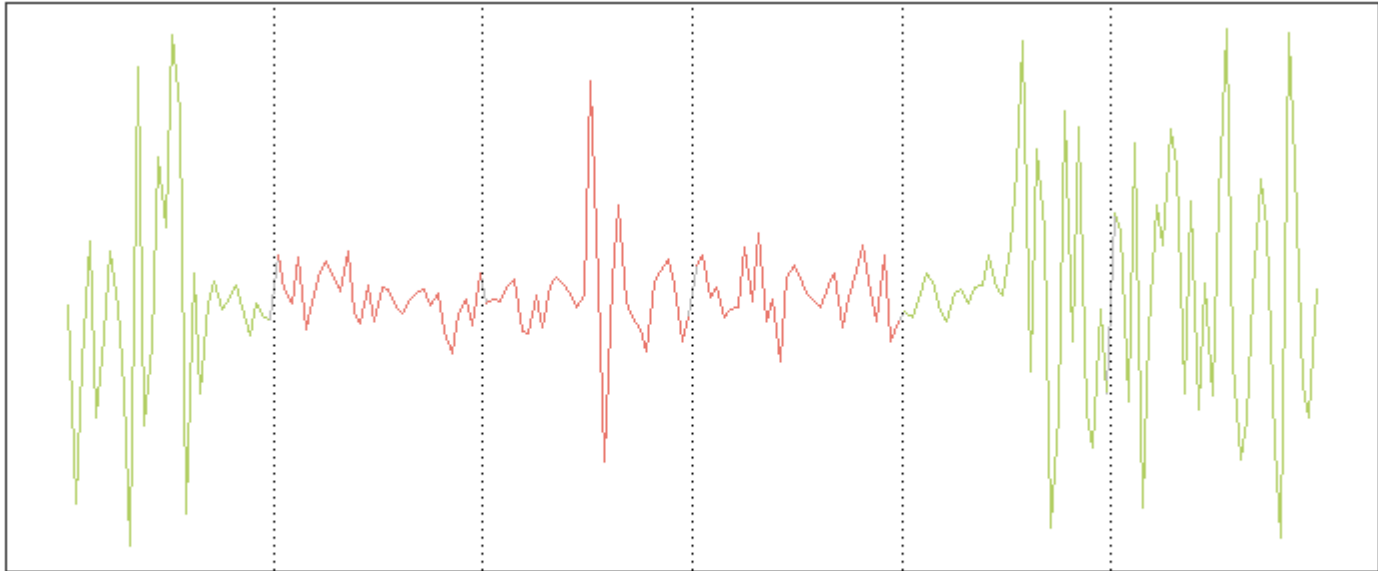


# ... Break into 30s intervals ...



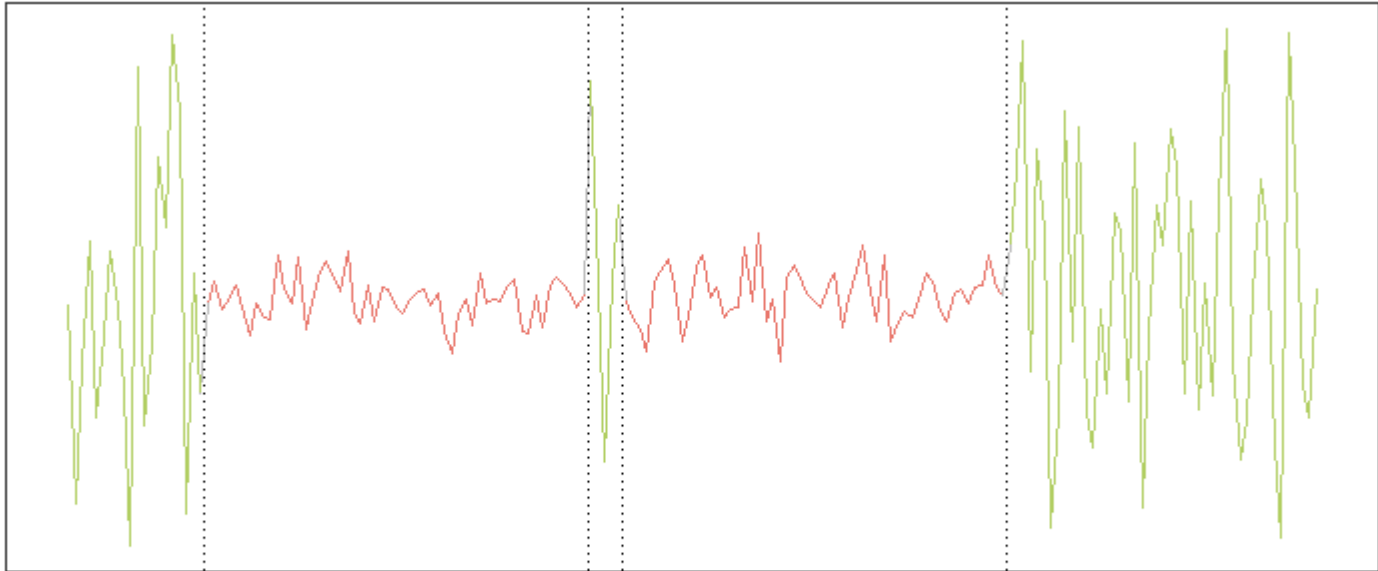
— 1 — 2 — 3 — 4 — 5 — 6

# ... and classify each interval

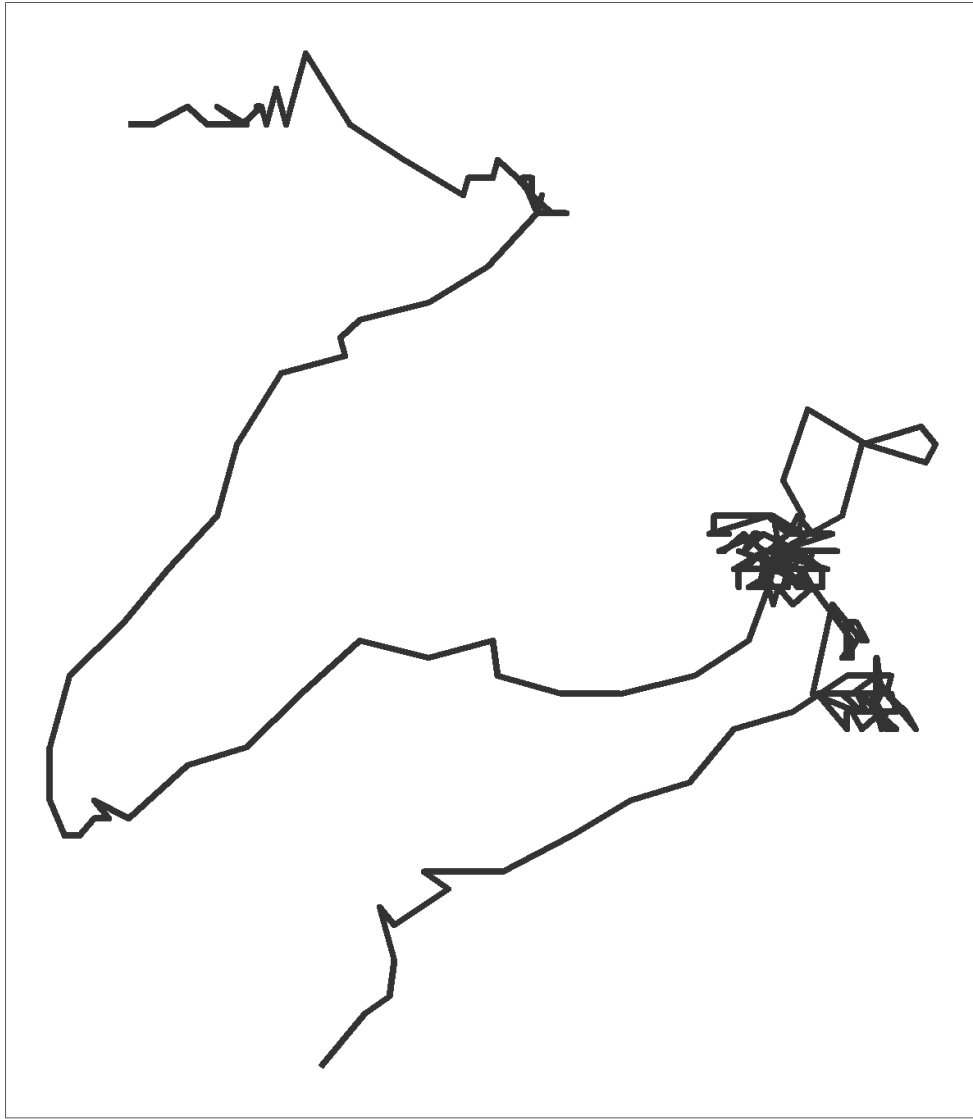


— Doing something — Not doing anything

# Or derive the intervals from the data



— Doing something — Not doing anything







● Stationary ● Foraging ● Walking

# Changepoint Detection

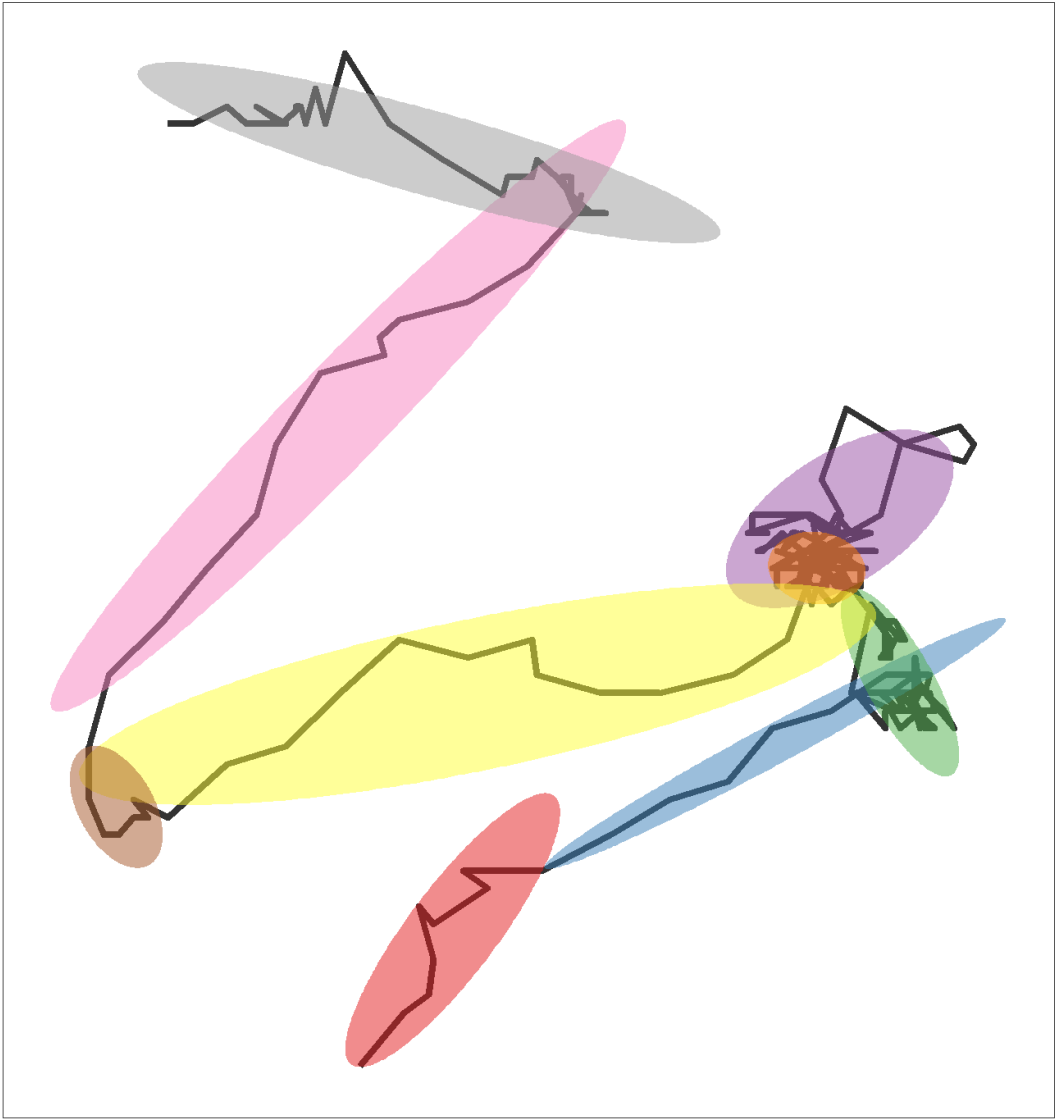
James NA, Matteson DS (2014). “ecp: An R Package for Nonparametric Multiple Change Point Analysis of Multivariate Data.” *Journal of Statistical Software*, 62(7), 1–25. <https://www.jstatsoft.org/v62/i07/>.

## Features

- Multivariate
- Non-parametric
- Multiple changepoints
- $O(N^2)$

# Changepoint Features

- Timestep
- Distance
- Speed
- Angle



# Classifier Features

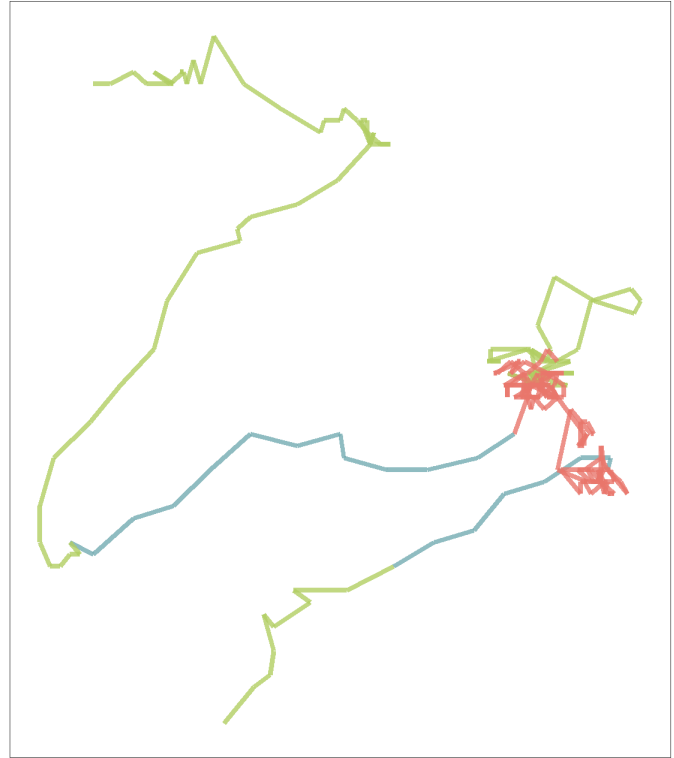
- Speed
- Ellipse
  - Length of major and minor axes
  - Area (unscaled and scaled by duration)
  - Ratio of axes (tortuosity)

# Decision Tree

- Speed, Area (scaled), Tortuosity
- Slow ( $< 0.43 \text{ m/s}$ )
  - Small area : Stationary
  - Large area : Foraging
- Fast ( $> 0.43 \text{ m/s}$ )
  - Low tortuosity : Walking
  - High tortuosity : Stationary



● Stationary ● Foraging ● Walking



- Stationary - Foraging - Walking

# Accuracy and Uncertainty

- About 75%, but...
  - Need to compare point observations to interval predictions
  - No peeking at the hold-out set
- Probably want to quantify uncertainty
  - At multiple levels of detail