Software Tools for Analysis of Data from High-Resolution Animal-Borne Tags

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Motivation

Bio-logging studies with high-resolution movement-sensors offer opportunities to observe animal behavior in unprecedented detail, but analysis of the resulting data is often complex, and there is a need for freely available, easy-to-use, flexible, well-documented software tools to facilitate analysis and interpretation.

Specifications

We introduce a new open-source tool kit for processing data from tags with high-resolution movement sensors. Here, high-resolution means sampled multiple times per second, and movement sensors include:

- Pressure Sensors
- Magnetometers
- Accelerometers
- Gyroscopes

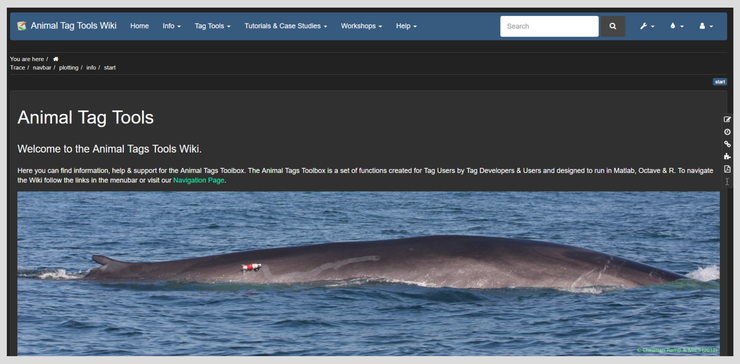
Currently, versions of the tools are available for:

- Matlab
- R
- Octave

Web Resources

animaltags.org

A wiki with detailed documentation of all tools, software downloads, tutorials, example datasets, workshop information, and more is at animaltags.org.



Software Repositories

Development versions of the tool kit are available from animaltags.org (past workshops section) and from github.com/stacyderuiter/TagTools. The R package can be installed from github and will be distributed via CRAN soon.

Contribute

Are there tools you would like to see implemented in the tool kit? Found a bug? Would you like a workshop at your institution?
Please get in touch. Several of us are at the conference, or email stacy@calvin.edu.

Workshops

- In August 2017, a three-day introductory workshop at the University of St Andrews was attended by 30 participants representing 7 countries and 18 home institutions.

- A second workshop is planned for October 2017 at Aarhus University in Denmark.
- A third one-day workshop will take place at the Society for Marine Mammalogy Conference in Halifax, Nova Scotia, Canada in October 2017.

Reading and Writing Data

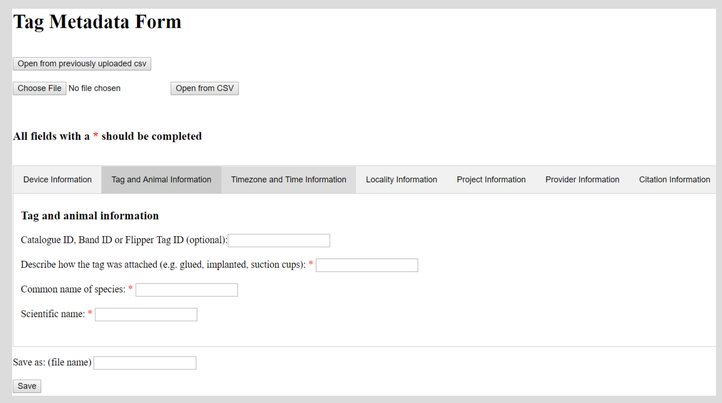
Supported Tag Types

The tool kit will include functions to read in data from several common types of high-resolution movement-sensing tags, including:

- 3MPD3GT (Little Leonardo)
- Acousonde (Greeneridge Sciences, Inc.)
- CATS (CATS, Customized Animal Tracking Solutions)
- DailyDiary (Wildbyte Technologies)
- DTAG (https://www.soundtags.org/)
- OpenTag (Loggerhead Instruments)

Attaching Metadata

A simple user interface for appending user-supplied metadata to a tag dataset is also provided.



Archival Storage Format

Tag data and metadata can be saved together in a well-defined standard file format, netCDF. (The tool kit includes functions to create, append data to, and load netCDF files.)

Calibration and Validation

Tools are provided to calibrate and validate tag data. For example:

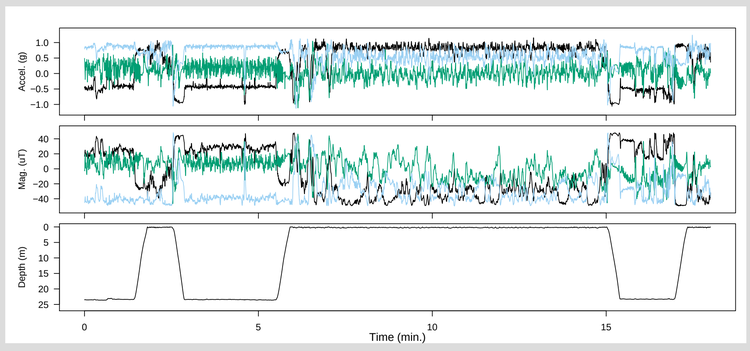
- Convert from tag-centric to animal-centric frame of reference
- Correct a depth or altitude profile for offsets caused by mis-calibration and temperature
- Estimate scale factors and offsets or calibration constants for measurements from triaxial field sensors
- Apply calibration constants to convert from raw measurements to standard scientific units of measure

Data Processing and Visualization

Tool kit data processing functions include utilities to:

- Compute derived metrics like jerk, overall dynamic body acceleration, and minimum specific acceleration
- Detect events
- Compute summary statistics for events such as dives or prey capture events

Visualization functions will facilitate plotting multiple exemplars of detected events, or creating multi-panel plots of multivariate time-series, and exploring and annotating tag data interactively.



Statistical Analysis

Statistical analysis functions include Mahalanobis-distance-based dimension reduction/change-point detection, 3D track reconstruction, and a rotation test for changes in event rates.

Acknowledgements

We gratefully acknowledge support from the U.S. Office of Naval Research via grant N000141613089.