trip_parameter_analysis.py User Guide

User Guide for Foraging Trip Detection and Trip Parameter Extraction

Purpose. This script identifies foraging trips from GPS data using a colony-based distance threshold and calculates trip-level metrics including duration, distance, and flight/landing time budgets. It also provides diagnostic outputs such as speed histograms to support threshold selection.

1. Overview

• The script is intended for biologging datasets containing at least time, latitude, and longitude columns.
• It is particularly useful for analysing foraging behaviour of seabirds breeding at fixed colonies.
• The recommended workflow is: run the script, inspect the speed histogram, choose an appropriate flight threshold, and interpret trip metrics.

2. Expected Input

Required columns: time, latitude, longitude

Optional column: speed, number_of_satellites

3. Input Parameters

Timezone offset: Convert UTC to local time.
number_of_satellites: Optional filter for GPS quality.
Colony coordinates: Define origin of trips.
UTM zone: Used for distance calculation.
Minimum trip duration: Defines valid trips.
Distance threshold: Defines departure/return.
Flight speed threshold: Used to classify flight vs landing.

4. Speed Threshold Selection

The flight/landing classification is based on speed. Users should inspect the histogram of speeds (Fig. 1) and select a threshold that separates low-speed (resting or landing) from high-speed (flight) behaviour.

5. Example Run

```
python trip_parameter_analysis.py
----------------------------------------------------------------------
Starting trip_parameter_analysis.py
This script analyzes foraging trips using GPS data downloaded from BiP.
----------------------------------------------------------------------
1. CSV filename to analyze (omit .csv if desired): 9B41870_TS-AxyTrek_Movebank_YNo.6_release20210824
2. Output time zone offset from UTC (e.g., Tokyo = 9) [9]:
3. Minimum number_of_satellites (press Enter to use all) [4]:
4. Colony latitude [39.401]:
4. Colony longitude [141.997]:
5. UTM zone used for distance calculations [54]:
6. Minimum trip duration (h) [10]:
7. Distance threshold (m): trip starts when the bird exceeds this distance from the colony and ends
when it returns within it [500]:
----------------------------------------------------------------------
Reading CSV file...
Removed 9533 rows using number_of_satellites >= 4.
Original row count: 17445001
Valid GPS positions: 9669
UTM EPSG used: 32654
----------------------------------------------------------------------
Creating speed histogram...
Saved speed histogram: 9B41870_TS-AxyTrek_Movebank_YNo.6_release20210824_speed_histogram.png
8. Flight / landing speed threshold (m/s) [3]:
----------------------------------------------------------------------
Extracting trips...
----------------------------------------------------------------------
Analysis completed.
Number of detected trips: 3
Output CSV file: 9B41870_TS-AxyTrek_Movebank_YNo.6_release20210824_trip_parameters.csv
----------------------------------------------------------------------
Output columns
  - trip_no
  - trip_status
  - trip_start_datetime
  - trip_end_datetime
  - trip_duration_h
  - number_of_positions
  - max_distance_latitude
  - max_distance_longitude
  - max_distance_datetime
  - max_distance_km
  - total_distance_km
  - mean_flight_speed_mps
  - max_flight_speed_mps
  - total_flight_time_h
  - total_landing_time_h
  - flight_ratio_percent
----------------------------------------------------------------------
```

6. Output Files

*_trip_parameters_en.csv: Trip-level summary including duration, distance, and activity budgets.
*_speed_histogram.png: Histogram used for threshold selection.

7. Practical Notes

- Always inspect the speed histogram before selecting a threshold.
- GPS quality filtering may improve results.

• Visual inspection of tracks is recommended.
• Thresholds should be biologically meaningful.

Example Output Figure

This figure (Fig. 1) shows an example of a speed histogram for a GPS-tracked Streaked Shearwater.

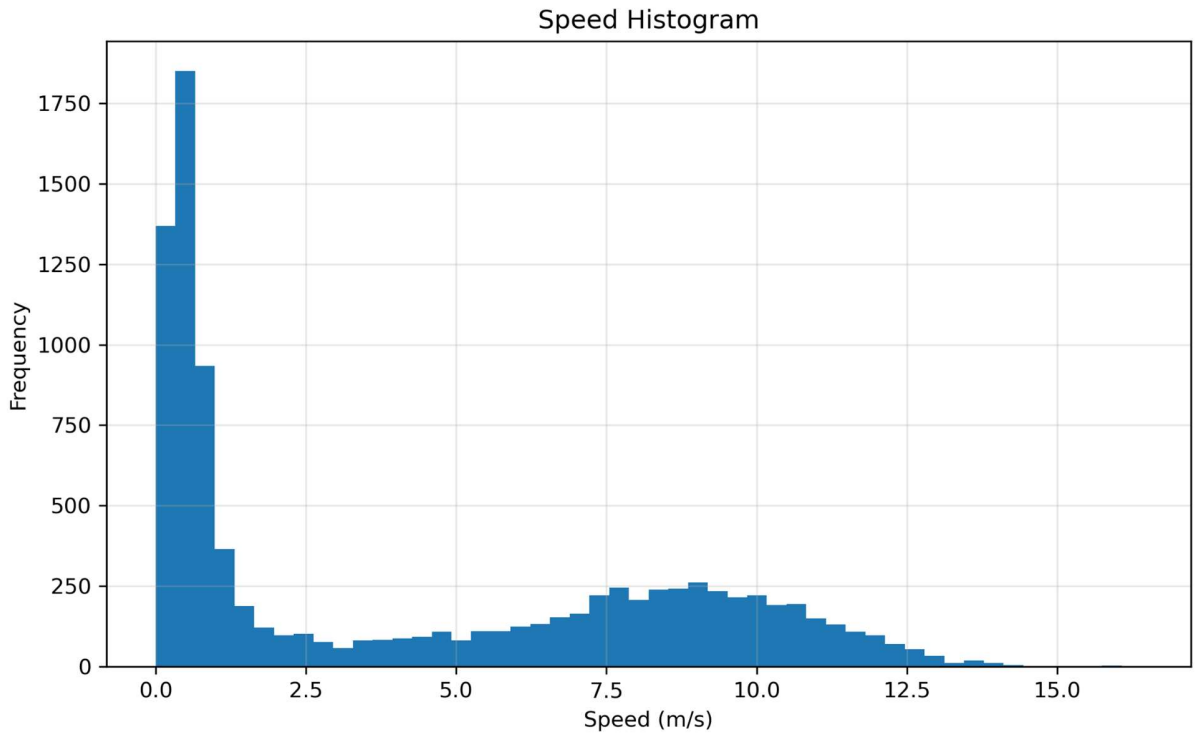

Fig. 1. Example speed histogram. The bimodal distribution typically reflects resting/low-speed behaviour (left peak) and flight (right peak). A threshold around 2–3 m/s is often appropriate, but should be selected based on the dataset.