



BIG DATA ANALYSIS APPROACH FOR ELLIPTICAL PATTERN IDENTIFICATION

RILEY DOYLE, RODNEY MCCOY, LOUIS LOPEZ

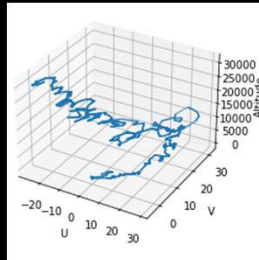


OBJECTIVE

Develop a Python program to automate the identification of elliptical structures in weather balloon flight profiles. Program must be able to analyze multiple large datasets.

BACKGROUND

- The University of Idaho (UI) has been involved in a multi-institutional effort to quantify AGWs in the stratosphere.
- AGWs are a wave-based transfer of momentum and pressure through the atmosphere that can be caused by topography, weather patterns, and solar eclipse events.
- To detect AGWs, the UI team launches radiosonde instrumentation via high altitude balloons. When a radiosonde interacts with an AGW, the wave motion causes the radiosonde to travel in an elliptical pattern over a fixed altitude rise.
- The UI team and their collaborators collected profiles from flights in Chile during a total solar eclipse and the individual flight profile analysis is still on-going.



VALUE PROPOSITION

- Reliably detect AGWs in flight profiles to help improve future climatological models.
- An easy-to-use Python program can be deployed on future campaigns in 2023 and 2024 to drastically decrease the labor required to analyze flight profiles.

REQUIREMENTS

- Develop and implement Python algorithm to detect potential AGW candidates in flight profiles
- Design an easy-to-use user interface and package program for deployment on future campaigns.

PROGRAM DESIGN

- The algorithm we decided to use for ellipse detection is a Randomized Hough Transform (RHT) which takes the following steps:

- Fit ellipses with three randomly selected points
- Score the fit of the ellipse corresponding to the three points
- Output the best fit ellipses

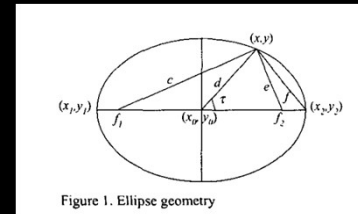
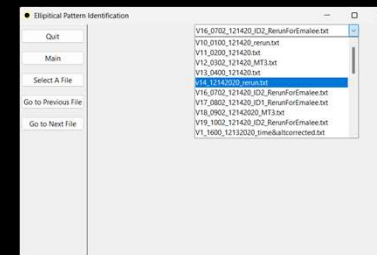


Figure 1. Ellipse geometry

The three randomly selected points are represented by (x, y) , (x_1, y_1) , and (x_2, y_2)

VALIDATION

- Algorithm can locate potential ellipses in flight profiles to help locate AGWs and reduce overall labor when analyzing flight profiles
- Graphic User Interface facilitates efficient processing of large batches of flight data by the algorithm.
- Quick Installation And Running Of The Application Allows Ease Of Use Of Its Functionality In Any Environment



SUMMARY

- Validation results show that the developed algorithm can assist the detection of AGWs in flight profiles.
- Validation also shows that a user interface has been developed that is east-to-use for future researchers that are not familiar with programing
- Future Improvements
 - Requires parameter adjustments between flight profiles
 - Struggles with time efficiency

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2023 Capstone Project