Roads of the Sea

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Introduction

Roads of the Sea (ROTS) is a multi-year project with the purpose of developing a route prediction system that helps mariners find optimal oceanic routes.

The primary task of this year (23-24') is to filter and annotate geospatial data that is converted from Automatic Identification System (AIS) data, resulting in more accurate data that would be helpful for future use.

Data & Tools

AIS is a vessel tracking system used to extract ship routes. These routes are generated as geometric shapefiles with the help of a ROTS developer. Each corridor (route geometry) is drawn using one or multiple polygons.

Additionally, each set of geometries has a statistics file, which stores vessel and trip data for each corridor, and an envelope file, which splits each corridor into smaller partitions.

The project uses QGIS externally to visualize and test these shapefiles on a real world map. Additionally, geopandas and pandas Python libraries allow for data manipulation with the shapefiles and statistics.

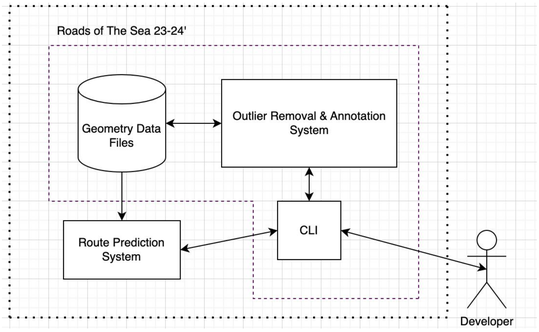
Requirements

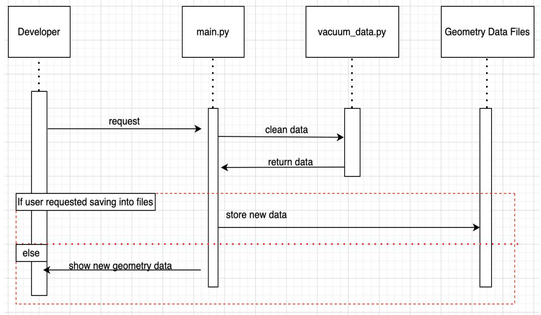
Functional Requirements:
Allows users to remove or annotate corridors that are considered "outliers" using two geometrical and one statistical approach, with the goal of filtering and improving data.

Nonfunctional Requirements:
Provides users to easily populate visually interpretable output files in a short span of time in order to debug finalized data using QGIS.

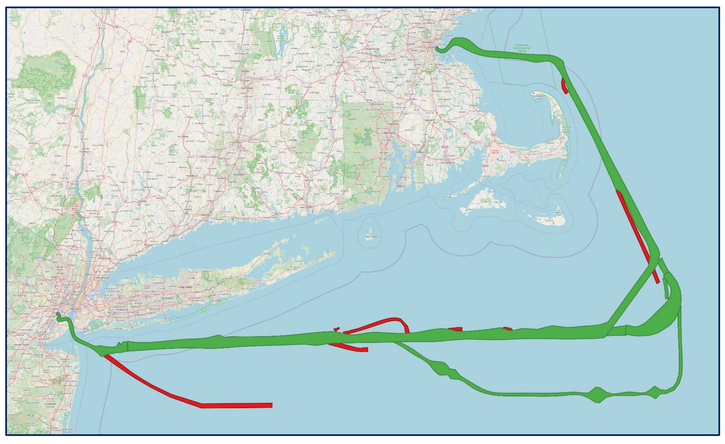
Design

There are four main components in ROTS. First, the geometry data files that contain geometric and statistical geospatial data used in Route Prediction System. Second, the Outlier Removal and Annotation System that utilizes the geometry data files using Python libraries mentioned under *Data & Tools*. The CLI (Command Line) is used to access the project. Lastly, the Route Prediction System is existing work made by another ROTS developer that we are trying to improve with more accurate data.





Results



Pictured on the left are the full set of vessel corridors from Boston to New York. These are outputted to QGIS. The green shapes are the paths that are kept, and the red ones are the corridors that were determined to be outliers through our algorithm.

Pictured on the right is the annotation system for Boston to New York, that shows which corridors (represented by id) are considered outliers and their type, represented by an 'x'.

id	corridor_outlier	envelope_outlier	statistic_outlier
1			
2			
3			
4			
5	x		x
6			x
7	x		x
8			x
9	x	x	x
10	x	x	x
11	x		x
12	x		x

Methodology

The path remover and annotator functions off the outlier detector, which uses two approaches.

- Geometrically, we can add a buffer around the **corridor** or its end **envelopes** to see if it does not overlap with other corridors. This would indicate that a corridor is a dead end or superfluous.
- Statistically, we can utilize each corridor's trip data to see which paths are taken the least to reach the appropriate destination.

Testing

Geometric shapefiles provided by our sponsor were the main source of our testing and QGIS was used to visualize our results. Different source-destination pairs of shapefiles used for testing the methods mentioned above. However, due to a change in company and AIS ownership, we unfortunately lost the rights to lots of the data and were left with minimal test cases, specifically for the statistical and envelope approaches.

Conclusion

The process of data cleaning/filtering corridor geometries was successful in making progress towards ROTS' route prediction system, as it successfully eliminated outliers which will reduce computational costs, increase the safety for mariners, and improve the accuracy and functionality for route prediction users. Unfortunately, due to a lack of testing in certain parts of the project, it is not expected to be as accurate in bigger and more complex test cases.

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