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Peculiarity Rule Mining for Maritime Traffic Outlier Detection

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Abstract

The large maritime traffic volume and its implications in economy, environment, safety, and security require an unsupervised system to monitor maritime traffic. In this work, a method is proposed to automatically produce peculiarity maritime traffic representations from historical self-reporting positioning data, more specifically from automatic identification system data. Finding outliers in collection of patterns among AIS trajectories is critical for real time applications ranging from military surveillance to transportation management. So that we proposed the method to measure the similarity between trajectory points and clusters, cluster relative distance and cluster angular distance. Finally, the novel method presents a light and structured representation of the maritime traffic, which sets the foundations to real-time automatic maritime traffic monitoring, anomaly detection, and situation prediction.

Keywords: Pecularity mining, marine traffic, trajectories, Anamoly detection.

1. Introduction

Oceans cover a 71 percent of the Earth surface, their great extension hinders their monitoring and surveillance, implying the supervision of coastal and open sea areas. Such enormous playground is also scenario of numerous activities which have a high impact on security, safety, economy and environment. Maritime surveillance represents a challenging research field due to the broadness of the coverage area and the variety of monitoring activities, e.g. irregular migration, piracy, fisheries control or traffic monitoring. The main target in maritime surveillance is to enable the automatic monitoring, analysis and understanding of activities at sea, typically named Maritime Situational Awareness (MSA). For the maritime surveillance enhancement, diverse technologies have been deployed, such as vessel positioning systems or meteorological and oceanographic sensors. As a result, a large amount of heterogeneous data sources feed the maritime surveillance systems. The fusion of such data sources enables the creation of a real-time picture of the situation at sea and enlarges the available knowledge. The presented recommendation system for Maritime Traffic Outlier Detection allows recommending the sailors to make the easy way of transportation and safety journey

1.1.1 Route Recommendation System

The route recommendation system is one that recommends the prospective route system to the user based on the AIS data set. This route will be designed with the help of Shared Nearest Neighbour (SNN) Algorithm to clustering high-dimensional data with the ability to find clusters of varying route density. SNN assigns objects to a cluster, which share a large number of their nearest neighbors.

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1.1.2 Peculiarity Generation System

The generation of peculiarity prediction system is done based on the list of routes recommended by SNN. This route is generated based on factors such as shortest path (remove unwanted cluster using DBSCAN), and various factors that to classify using algorithm. In this components, we present a distance-based trajectory outlier detection method on AIS data. The method use DBSCAN clustering on historical AIS trajectory point data, produce the normal clusters of moving points and stay points, then extract most efficient path from these clusters.

2. Literature Survey

Recommending route to users of different place in a user personalised way is the main aim of this project. Apart from recommending prospective locations to users to make the journey safety. Recommending the route for the sailors to make safety journey [1]. The main objective of the work is to make a clustering-based maritime traffic anomaly detection mode. This work is to find place (Longitude and Latitude), the model can also take speed and direction into account while deciding the abnormality(ship) of a single trajectory point. This Predictive models usually predict future status information of a particular vessel and then compare the real data with the prediction to decide the abnormality. It is indeed very important to predict what a user would rate an unrated location based on his/her previous ratings to other locations. This, [2] is one to make Position sensing techniques and location-aware devices, trajectory pattern detection for the mining of movement behavior, location prediction for the users of mobile devices. Automatic Identification System (AIS) in the maritime domain an effective automated method for mining trajectory data and detecting anomalies would be a valuable contribution to maritime surveillance. This paper explores the maritime trajectory data for anomalous behavior detection. It make a wide contribution over Maritime trajectories are prone to the typical data uncertainty inherent in the trajectories of moving objects as well as those imposed by the unconstrained movement of objects upon the surface of the sea. From the knowledge of previous paper and the [3] to make a distance-based approach for trajectory outlier detection on trajectory data. First, they apply Density Based Spatial Clustering of Applications with Noise (DBSCAN) to generate patterns from original trajectories, It can detect distance anomaly and speed/heading anomaly effectively and greatly reduces computation cost. It extract GV and SSP from DBSCAN clustering results, reduce the vast amount of trajectory points to far smaller data set.

Outlier Detection Method on Maritime Traffic Data was mentioned [4] through AIS. As a result of establishment of Automatic Identification System (AIS) networks, maritime vessel trajectories are becoming increasingly available. Finding outliers in a collection of patterns among AIS trajectories is critical for real time applications ranging from military surveillance to transportation management. In this paper they present a distance-based approach for trajectory outlier detection on trajectory data. First, they apply Density Based Spatial Clustering of Applications with Noise (DBSCAN) to generate patterns from original trajectories. Second, they extract gravity vectors and sample stop points from clusters to retain stop and move information and to reduce the further computation cost. To measure the similarity between trajectory points and clusters, cluster relative distance and cluster angular

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distance are proposed. Finally, they present experiments on real AIS data at Chinese QiongZhou strait. The experiment results show that their methods can detect distance anomaly and speed/heading anomaly effectively and greatly reduces computation cost.

3. Proposed Method

A Route recommendation makes the data using different algorithms and recommends the most relevant routes to ships. It first captures the past route and based on that, recommends route which the ships might be likely to use.

Route Recommendation can be done by two ways:

- To choose a route which are most popular among all the route and recommend them to the ships.
- Divide the users into multiple segments based on the previous data and make a most sophisticated route over a period of time.

3.1 Working of a Route Recommendation System

The following are the different phases involved in the building of the recommendation system:

- Route Data Collection
- Route Data Clustering
- Route Prediction

3.2 Route Data Collection

This is the first and most crucial step for building a recommendation system. The data can be collected from automatic identification system to make the route from all the ships make a transportation over a period of time.

3.3 Route Data Clustering

Clustering is the task of grouping a set of objects in such a way that objects in the same group are more similar to each other than to those in other groups. It is a main task of exploratory data mining.

3.3.1 Route Prediction

The semantic routes are derived thereafter, once obtain some active waypoints and we start seeing vessel trips for one waypoint to another. A semantic route becomes active once a minimum number of trips is observed along it. Moreover, the management of the semantic routes is dynamic since they follow the evolution of waypoints. More specifically, semantic route objects get updated if Ports and Entry/Exit gates are created, expanded and merged. DBSCAN is used on the routes as well, as a post-processing tool to filter out outliers and noise points from the route detections. The make route for the ships.

3.4 ARCHITECTURE FRAMEWORK

In this section, we present an overview of our proposed framework, called MT-MAD (Maritime Trajectory Modeling and Anomaly Detection). Given a set of moving objects and their trajectory streams as detected by a monitoring system, the objective of the MTMAD is to explore frequent movement behavior, evaluate the degree of suspiciousness of sub-trajectories, and then detect anomalies. Maritime trajectory modeling Prior to AD, the Maritime Trajectory model (MT model) is derived from the maritime trajectory database. To deal with the uncertain property of trajectory data for moving behavior discovery, the frequent region is extracted to represent the precise locations where the objects often visit.

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Based on a set of frequent regions derived, each raw trajectory is transformed into a region-based movement sequence. As such, the proposed MT model is able to capture movement behavior among frequently visited regions. Specifically, the algorithm of MT model construction is designed by considering outlying features of maritime trajectory.

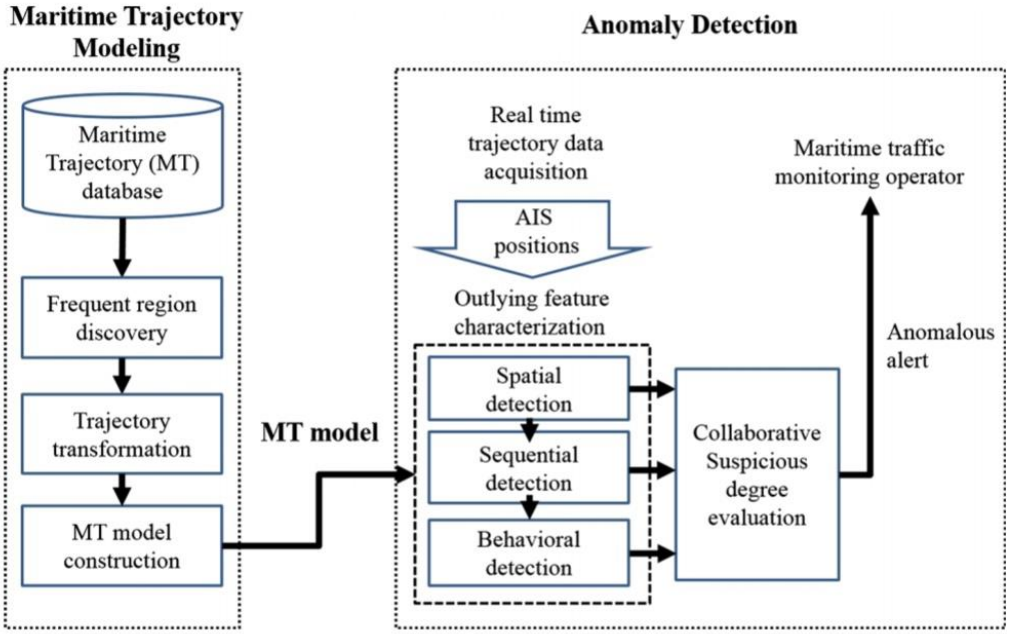

Figure 4.1 Framework for Maritime Traffic Outlier Detection

Anomaly detection In light of derived MT model, given a set of moving objects and their trajectory streams, we intend to detect anomaly by their suspicious degree. For each snapshot trajectory in a moving object's trajectory stream, we first identify its outlying features by anomaly detectors. The suspicious degree is evaluated by identified outlying features. Then, the snapshot trajectory is labeled as an anomaly if its suspicious degree is equal or greater than the user-defined threshold. The implementation of the project is to be one in python. The main algorithm used here is collaborative filtering.

4.2 DBSCAN FOR PECULIARITY RULE MINING (MARITIME TRAFFIC OUTLIER DETECTION)

Algorithm

Input: Latitude and Longitude as in .csv file

Output: Core cluster and noise data

1: Get the list of latitude and longitude of the ships from ais
2: Calculate the minimum numbers of points to form a cluster and the distance between them
3: For each un visited point p
4: Mark p as visited
5: D(p)=[ ];
6: If p is a stop point

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7: For all stop point q the distance betweebp,q < epsilon
8: Generate density reachable setD(p)
9: else
10: for all moving point q the distance between p,q<epsilon
11: Generate density reachable set D(p)
12: If Size of(D(p)) < minpts them
13: Mark p as noise
14: else
15: Create a new cluster from(p(D))
16: Add the core point p of new cluster to S or C
17: End

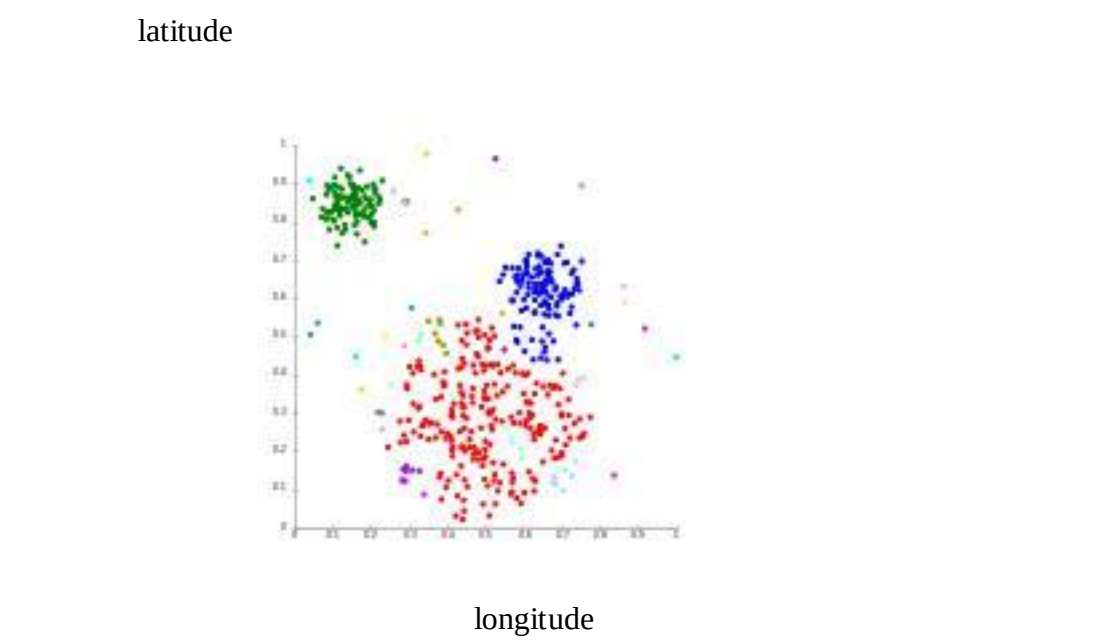

Figure 4.2: DBSCAN OUTPUT

output:

The accuracy of the algorithm is more because the minimum points to form a cluster as bean increased to 10 and minimum Euclidean distance between the points as bean reduced to 1 units.

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4.3 FLOW DIAGRAM

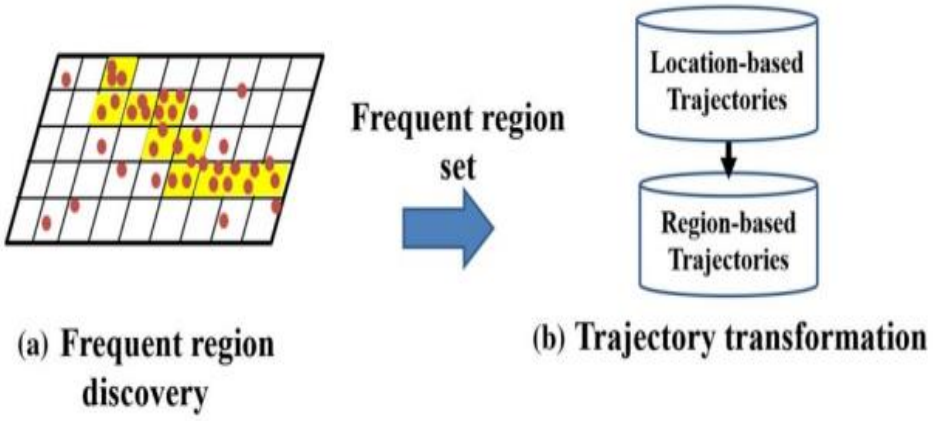

Figure 4.3: flow diagram for Region Discovery

The given flow diagram Fig.4.3 the grip plot is made from the latitude and longitude obtained from the a is (automatic identification system) and cluster is obtained when dbscan(Density-based spatial clustering of applications with noise) is applied on latitude and longitude.

4. Result and Discussion

This work provides the route recommendation system which built the efficient route for the ships in the ocean. So that anomalous ships can't deviate from the route. This route will be design by the AIS data set and the noise will be removed using DBSCAN. Thus the AIS data has identified and the latitude and the longitude of the ships from the previous data and clusters are formed using DBSCAN. Future work will be employed to the project is to tracing the individuals ships routes in the ocean .It also enhance the identify the correct anamolous ships and to Detecting the correct location of the ships.

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