What else can AIS data provide?

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Summary

The Automatic Information System (AIS) is a ship identification system which is required to be carried by the majority of merchant ships and can be carried voluntarily by small private crafts. It is a VHF based system whereby ships within radio range of each other exchange position, course and speed data, as well as destination and other vessel specific details within seconds. This transmitted data is monitored, and recorded, ashore, which therefore provides instantaneous data concerning the shipping in the vicinity. This paper reviews the additional information that can be extracted from analysing these very large data sets such as ship size trends and ship traffic over the years.

Keywords: Traffic monitoring, AIS data, Data processing, Ship sizes, Shipping trends

Introduction – Data Source

The Automatic Information System (AIS) is a Very High Frequency (VHF) Radio based system designed to allow ship and shore based stations to automatically exchange position and identity information. It must be carried by all passenger ships, cargo ships above 300gt trading internationally and 500gt not trading internationally. Data is transmitted based on the speed and manoeuvring of the ship, with fast vessels altering course transmitting position course and speed data at 2 second intervals. Other data concerning identity, size and type of vessel is transmitted at slower rates. In the example used for this paper, data was acquired commercially for a coastal area defined by latitude and longitude co-ordinates (approximate area of 105 x 165 nautical miles). To reduce the size of the data-set, information was requested at 5 minute intervals for a five year period (2015-2019). This resulted in close to 5 million lines of data for the five year period.

Data Processing

Each line of data included ships name, International Maritime Organisation (IMO) number, length, beam, draft, nationality (from callsign), type of vessel, type of dangerous cargo (if any), destination and navigational status. In order to process such large quantities of data appropriately, Power BI and MATLAB were used. Algorithms were written to pre-process the dataset for illogical or erroneous entries within the dataset. For example, vessels with unrealistic dimensions or speeds were identified and removed from the dataset. Then, each entry was sorted into groups according to vessel type i.e. cargo carrier, fishing vessel etc. Once the data has been pre-processed, further custom sorting algorithms could be applied to reveal various useful insights as discussed below.

Ship Size & Transit Trends

By sorting the data for the mean, maximum and minimum ship lengths with respect to year, the changes in ship size over the period can be observed. Figure 1 shows that while maximum length of cargo ships has increased, the mean length remains relatively constant. This suggests that although longer cargo ships have been introduced, the number of such ships are relatively small. A similar review of ship's drafts shows that the drafts have also not changed substantially over the 5 years (refer to Figure 2).
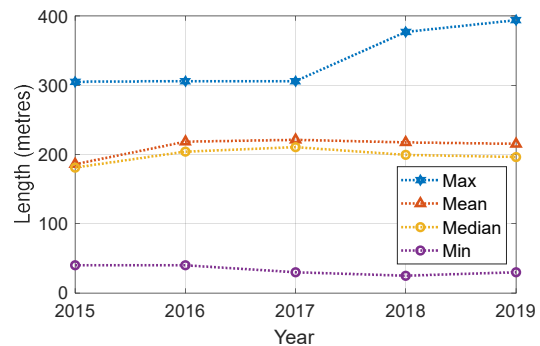

Figure 1: Cargo ship length trend over the 5 years. The maximum length may have increased over the years, but the mean length remains relatively constant.
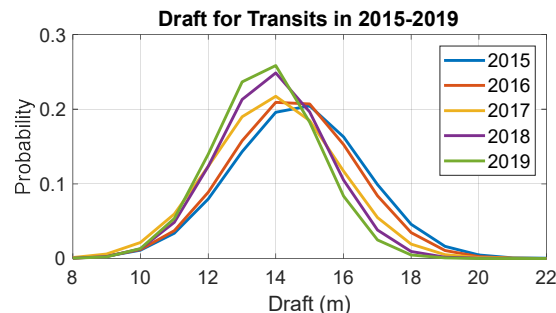

Figure 2: Distribution of ship operating drafts by year.

The number of transits through the observed area were also estimated by analysing the trajectories of each individual vessel across the area. The transits depicted in Figure 3 shows that there was a significant reduction in shipping during 2017 which

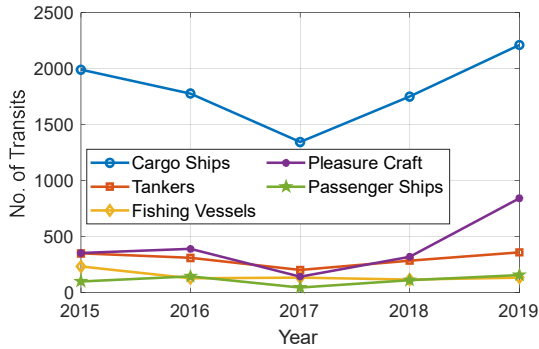was likely associated with the world trade downturn in 2016 [4].

Figure 3: Number of transits by vessel type over the years. The dip in 2017 was correlated to the world trade downturn in 2016 [4].

Ship Traffic Patterns

Plotting the coordinates of each ship transmission reveals the main shipping routes through the area, revealing the traffic pattern. A sample of the cargo ship traffic is illustrated in Figure 4. By undertaking a closer inspection of the traffic, the spread or otherwise the shipping route width can be estimated (Figure 5), as well as monitoring the effectiveness of traffic separation schemes in the area [2]. This also helps in developing risk mitigating strategies to improve traffic safety [3].
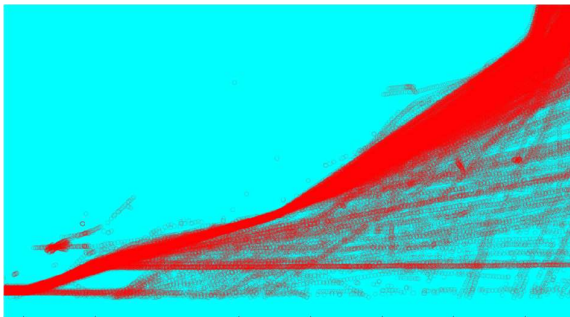

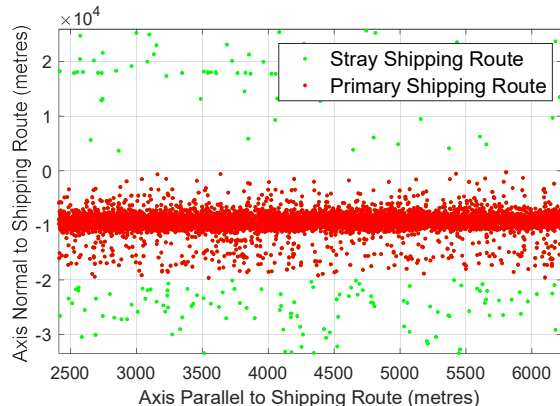Figure 4: Sample cargo ship traffic pattern.

Figure 5: Examination of the primary shipping route width.

Studying the shipping route width is essential for Offshore Renewable Energy Installation (OREI) projects. As suggested by the UK Maritime & Coastguard Agency in MGN654 [1], the positioning of offshore wind farms with respect to nearby shipping routes must be considered carefully (Figure 6).
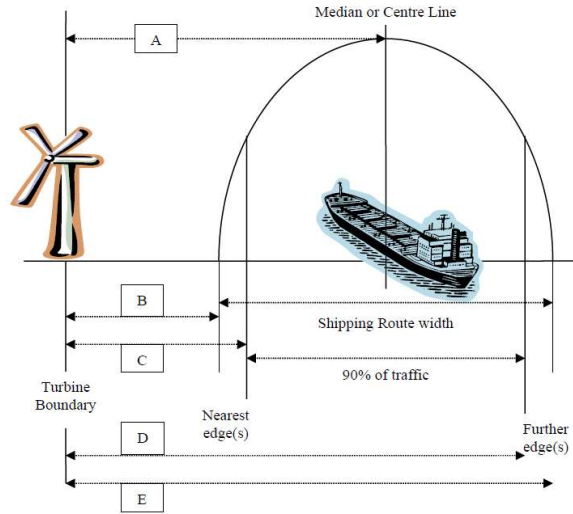

Figure 6: Guidelines are in place for positioning of wind farms with respect to nearby shipping routes (figure adapted directly from [1]).

Conclusion

AIS is a VHF radio system which enables ships and shore based stations to instantaneously exchange position and identity information. In manipulating and sorting the collected AIS data, further information became available, which provided a deeper understanding of the trends in ship sizes and types over the five years of the data set. It was noted that longer cargo ships have been introduced over the years but the mean length and draft has not changed substantially. Further, it was possible to identify the regular routes used by shipping and to identify the width of traffic routes and any changes over time.

References

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