A Study on Anchorage and Drifting Detection and Behavior Identification through Real-Time Vessel Data Tracking

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BACKGROUND & OBJECTIVES

Increasing maritime traffic, larger vessels, and expanding marine development and uses have made the maritime environment more complex and challenging. These changes raise concerns about collisions, groundings, and marine pollution, while making vessel traffic monitoring increasingly difficult for existing systems.

Addressing these challenges requires real-time analysis of vessel positions, speeds, and headings. Automatic Identification System (AIS) data play a key role in tracking vessel movements and monitoring traffic, but their application to real-time behavior analysis remains limited.

This study proposes an AIS-based vessel behavior identification and classification model. By detecting anchored and drifting vessels and recognizing route deviations and vessel activities in real time, the model aims to improve the safety and efficiency of vessel traffic management.

RESEARCH METHODS

The Busan Port area, home to diverse vessel types, was selected as the study site. To establish criteria for anchoring, drifting, and behavior identification, the study reviewed relevant laws and literature, selected vessel types with distinguishable activities, and analyzed AIS position data to derive movement patterns.

A model was then developed to process AIS data in real time and identify and visualize vessel positions, types, and states based on the derived criteria and patterns. Classification criteria can be finely adjusted to distinguish vessel states. Parallel processing was employed to handle large datasets quickly and improve model performance.

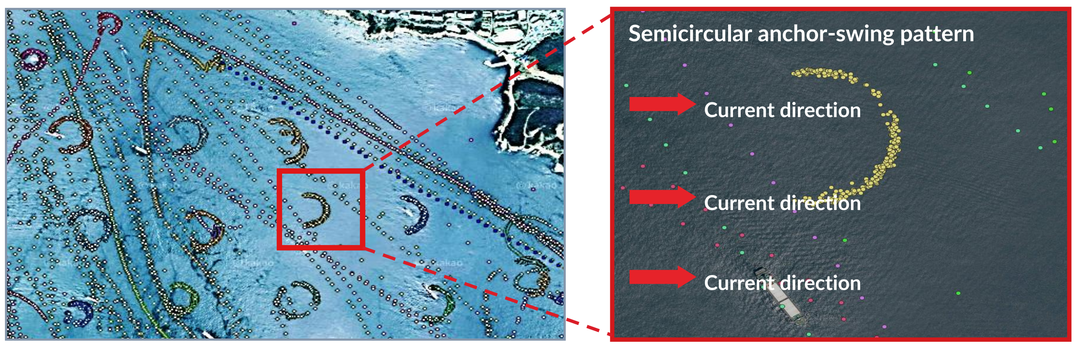


Figure 1. Anchored vessel movement patterns

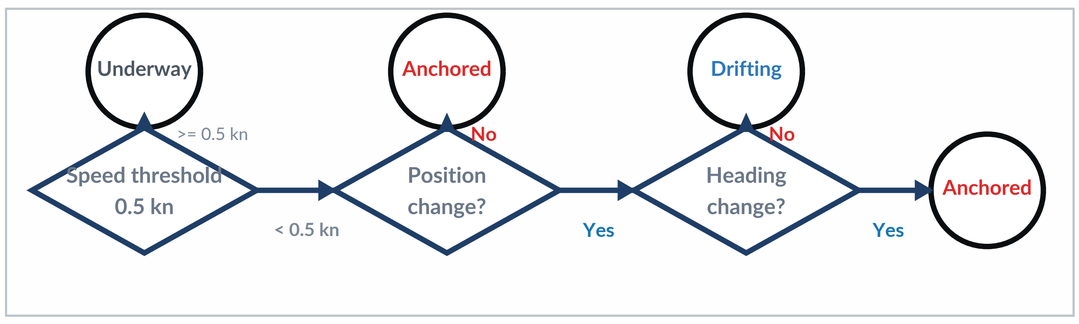


Figure 2. Anchoring and drifting classification algorithm

Vessel type	Activity	Criteria	Reference
Fishing vessel	Anchored / unloading	Anchored in harbor	AIS-based analysis of trawl-vessel occurrence and fishing-ground search in waters near Jeju Island (Lee et al.)
	Fishing	Speed <= 5 kn, sustained	
	Underway	Speed > 5 kn, sustained	
Tug / Tow	Towing work	Traveling with nearby vessels; speed <= 5 kn, sustained	Study on towing characteristics of damaged vessels (Seo et al.) / DEXTER OFFSHORE Ltd.
	Underway	Speed > 5 kn, sustained	
Yacht / Tour / Passenger / Fast	Boarding / alighting	Anchored in port / terminal	-
	Leisure / underway	Continuous movement otherwise	
Cargo / Tanker	Cargo handling	Anchored in port / terminal	-
	Underway	Continuous movement except anchoring / drifting	

Table 1. Vessel behavior identification criteria by vessel type

RESEARCH RESULTS

Underway	Route deviation	Anchored	Drifting	SOG
➡	⛔➡	●	⊖	0.0 ➡

Table 2. Real-time anchoring, drifting and route-deviation symbols

Vessel type	Underway	Boarding / Cargo	Fishing / Towing
Fishing vessel	➡	●	⊖
Tug / Tow	➡		⊖
Yacht / Tour	➡	●	
Passenger / Fast	➡	●	
Cargo vessel	➡	●	
Tanker	➡	●	

Table 3. Vessel behavior identification symbols

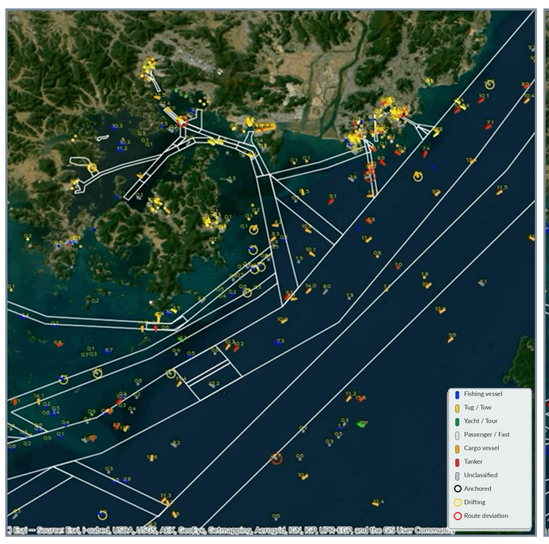


Figure 3. Anchorage, drifting and route-deviation detection in Busan

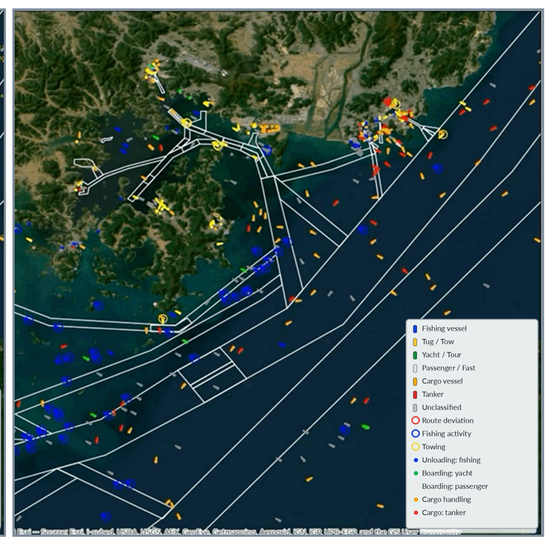


Figure 4. Vessel behavior identification in Busan

Real-time Anchorage, Drifting & Route Deviation (Fig. 3)

- AIS updates and monitoring at 1-second intervals
- Six vessel types; display position, SOG and heading
- Arrow-shaped vessel icons indicate heading
- Route deviation: red ring for 5 min; cleared upon re-entry
- Anchoring: within anchorage + movement pattern (type-colored ring)
- Drifting: outside anchorage + movement pattern (yellow ring)

Real-time Vessel Behavior Identification (Fig. 4)

- AIS updates and monitoring at 1-second intervals
- Six vessel types; display position and heading
- Classify vessel activities using the established criteria
- Identify fishing activity (blue ring)
- Identify towing operations (yellow ring)
- Identify unloading and boarding in ports/terminals (type-colored ring)

CONCLUSION

In the waters around Busan, the proposed model identified and clearly visualized vessel anchoring, drifting, and operational behaviors using the established criteria. Parallel processing optimized the model for handling large AIS datasets in real time.

Future work will extend the study across Korean waters, refine detection performance through algorithm tuning, and develop additional functions such as vessel-track visualization and accident detection. These improvements are expected to enhance maritime accident prevention and the efficiency of vessel traffic management.