

Specification

METHOD AND SYSTEM FOR IDENTIFYING ESTIMATED ARRIVAL PORT OF SHIP

Technical field

The present invention relates to a technical field of shipping informatization and intelligent navigation, and specifically relates to a method and system for identifying estimated arrival port of ship.

Background Technique

The identification of the estimated arrival port is also known as identification of the destination port of ship navigation. In addition to container liners with clear shipping schedule information, how to identify the destination ports of various dry bulk, liquid bulk cargo, special ships and other ships sailing around the world is a very challenging and indispensable aspect in the process of ship digitalization and shipping intelligence. At present, most of the industry's research on estimated arrival port focuses on real-time AIS data. The destination port is determined by various means, including pinyin recognition, machine learning and other technologies to identify AIS DEST. There are also a small number of studies that use big data technology to find patterns by analyzing historical route data. Among them, "Quick Query Method for Estimated arrival Ship Contact Information Based on AIS Data"

(Journal of Shanghai Maritime University, Vol. 31, No. 4, December 2010) and "Intelligent Translation Technology of AIS Pinyin Ship Name to Chinese Characters" (Journal of Dalian Maritime University, No. 46(02), 2020) are representative technologies, but these algorithms or academic papers mainly have following problems:

1. They only rely on AIS data to match the destination port. Error of the data is conductive. A small mistake can lead to a completely wrong result. Moreover, when matching, the above solutions will ignore the most important step - AIS data cleaning;

2. AIS data can be misleading. Behavior habits of ship managers can lead to a completely wrong result in the matching of the destination port. Upon arrival at the port, to ensure safety, the ships will report accurate AIS destination port. When ships leave port, they may not change the AIS destination port. At this time, the destination port reported in AIS is still the destination port at the time of arrival. Analyses based on such AIS data must have a large error;

3. Ships that are not filled in the destination port will be directly removed. In fact, according to different ship types and deadweight tons, potential destination ports can be obtained through AIS trajectory and historical arrival and departure analysis;

4. Above solutions stay at analyzing static data, and do not have functions of repeated derivation and hypothesis testing.

Summary of the Invention

Aiming at the problems of error conductivity caused by relying on AIS data in existing estimated arrival port identification technology, the present invention provides a method for identifying estimated arrival port of ship. The method constructs a ship estimated arrival port matching model on the basis of historical records of the ship port call and matching records of AIS REST and final destination ports. The model takes origin port information and real-time AIS DEAR information as inputs, performs multi-level progressive identification through priority queue during processing, and finally returns the destination port with the highest matching degree. The present invention also relates to a system for identifying estimated arrival port of ship.

The technical solution of the present invention is as follows:

A method for identifying estimated arrival port of ship, comprising following steps:

based on the ship's AIS data, constructing a dynamic of voyage segments of the ship, and establishing historical records of the ship port call by using this dynamic;

establishing AIS DEST matching records, in reverse order according to the number of matches, according to the AIS DEST records of the ship and the final ports of call of the corresponding ship;

based on the established historical records of the ship port call and the AIS DEST matching records, constructing a ship estimated arrival port matching model, the ship estimated arrival port matching model has a potential destination port priority queue,

wherein the priority queue comprises: an intersection of the historical records of the ship port call and the AIS DEST matching records, AIS DEST destination ports matched by same ship type based on the AIS DEST matching records and AIS DEST destination ports matched by different ship types based on the AIS DEST matching records when the intersection is not obtained, and/or the number of calls at the destination port of the current original port segment based on the historical records of the ship port call when the intersection is not obtained; estimated arrival data of the ship's voyage obtained according to the optimal destination port identified by matching result of the ship estimated arrival port matching model.

Preferably, in order of priority from highest to lowest, the priority queue of the constructed ship estimated arrival port matching model comprises: the intersection of the historical records of the ship port call and the AIS DEST matching records, the AIS DEST destination ports matched by same ship type based on the AIS DEST matching records when the intersection is not obtained, the AIS DEST destination ports matched by different ship types based on the AIS DEST matching records when the intersection is not obtained, the number of calls at the destination port of the current original port segment based on the historical records of the ship port call when the intersection is not obtained, and the number of calls at the destination port of the current original port segment of all ships.

Preferably, in order of priority from highest to lowest, the priority queue of the constructed ship estimated arrival port matching model comprises: the intersection of

the historical records of the ship port call and the AIS DEST matching records, the number of calls at the destination port of the current original port segment based on the historical records of the ship port call when the intersection is not obtained, the AIS DEST destination ports matched by same ship type based on the AIS DEST matching records when the intersection is not obtained, the AIS DEST destination ports matched by different ship types based on the AIS DEST matching records when the intersection is not obtained, and the number of calls at the destination port of the current original port segment of all ships.

Preferably, further comprising a step of obtaining current shipping schedule data, constructing the ship estimated arrival port matching model based on the shipping schedule data, the historical records of the ship port call and AIS DEST matching records, and taking the destination port of the container ship obtained by performing match logic on the shipping schedule data as the highest priority of the potential destination port priority queue in the ship estimated arrival port matching model.

Preferably, further comprising AIS DEST cleaning of ship AIS data, the number of matches is determined according to the AIS DEST data of the ship with uniform standards after cleaning and the ports of call of the ship segments, so as to establish the AIS DEST matching records.

Preferably, wherein considering matched optimal destination port, the estimated arrival data of the ship's voyage is obtained, the ship's estimated arrival time and remaining mileage can be further analyzed to provide API services to others.

A system for identifying estimated arrival port of ship, comprising a ship port call historical record module, an AIS DEST matching record module, and a ship estimated arrival port matching model construction processing module which are interconnected,

the ship port call historical record module, based on the ship's AIS data, constructs a dynamic of voyage segments of the ship, and historical records of the ship port call are established in this dynamic;

the AIS DEST matching record module forms mapping relationships according to ship's AIS DEST records and the corresponding ship's final port of call and arranges the mapping relationships according to the number of matches, so as to establish AIS DEST matching records;

the ship estimated arrival port matching model construction processing module, based on the established historical records of the ship port call and the AIS DEST matching records, constructs a ship estimated arrival port matching model, the ship estimated arrival port matching model has a potential destination port priority queue, wherein the priority queue comprises: an intersection of the historical records of the ship port call and the AIS DEST matching records, AIS DEST destination ports matched by same ship type based on the AIS DEST matching records and AIS DEST destination ports matched by different ship types based on the AIS DEST matching records when the intersection is not obtained, and/or the number of calls at the destination port of the current original port segment based on the historical record of

the ship port call when the intersection is not obtained; estimated arrival data of the ship's voyage obtained according to the optimal destination port identified by matching result of the ship estimated arrival port matching model.

Preferably, wherein the AIS DEST matching record module performs AIS DEST cleaning on the ship AIS data, determines the number of matches according to the AIS DEST data of the ship with uniform standards after cleaning and the ports of call of the ship segments, so as to establish the AIS DEST matching records.

Preferably, the system further comprising a shipping schedule data module to obtain current shipping schedule data, the shipping schedule data module is connected to the ship estimated arrival port matching model construction processing module, at this time, the ship estimated arrival port matching model construction processing module constructs the ship estimated arrival port matching model based on the shipping schedule data, the historical records of the ship port call and AIS DEST matching records, and takes the destination port of the container ship obtained by performing match logic on the shipping schedule data as the highest priority of the potential destination port priority queue in the ship estimated arrival port matching model.

Preferably, wherein the ship estimated arrival port matching model construction processing module, in order of priority from highest to lowest, the priority queue of the constructed ship estimated arrival port matching model comprises: the intersection of the historical records of the ship port call and the AIS DEST matching records, the

AIS DEST destination ports matched by same ship type based on the AIS DEST matching records when the intersection is not obtained, the AIS DEST destination ports matched by different ship types based on the AIS DEST matching records when the intersection is not obtained, the number of calls at the destination port of the current original port segment based on the historical records of the ship port call when the intersection is not obtained, and the number of calls at the destination port of the current original port segment of all ships;

or comprises: the intersection of the historical records of the ship port call and the AIS DEST matching records, the number of calls at the destination port of the current original port segment in the historical records of the ship port call when the intersection is not obtained, the AIS DEST destination ports matched by same ship type based on the AIS DEST matching records when the intersection is not obtained, the AIS DEST destination ports matched by different ship types based on the AIS DEST matching records when the intersection is not obtained, and the number of calls at the destination port of the current original port segment of all ships.

The beneficial effects of the present invention are as follows:

The present invention provides a method for identifying estimated arrival port of ship. This method constructs the ship segment dynamics based on the ship AIS data to establish the historical records of the ship port call, establishes AIS DEST matching records based on the number of matches generated by AIS DEST and the port of call of the ship segment, and then constructs the ship estimated arrival port matching

model according to the historical records of the ship port call and AIS DEST matching records. The model has a priority queue of potential destinations with a specific priority. The estimated arrival data of the ship's voyage obtained according to the optimal destination port identified by the model's matching results, and further analyze the estimated arrival port according to the matched destination ports. Due to the combination of the historical records of the ship port call and AIS DEST (destination port) matching records, when the destination port is unclear or ambiguous in the AIS data, the present invention can better reflect the real destination port of ship voyage. The present invention solves the problems of error conductivity in the existing estimated arrival port identification technology relying on AIS data. The present invention will optimize the record parameters and the model parameters after the ship berths. As the amount of data increases and the number of matches increases, the correct match rate will continue to increase. The present invention has a higher accuracy than the prior art.

The ship estimated arrival port matching model constructed in the present invention has a priority queue of potential destination ports, thereby forming an estimated arrival port algorithm, the algorithm is also a priority queue filtering relationship, which provides different and more targeted priority queues for the cases where the historical records of the ship port call intersect and don't intersect with AIS DEST matching records to protect multiple logical hierarchical queues. By combining the shipping schedule data, the present invention may also use the destination port of

the container ship obtained by the matching logic processing of the shipping schedule data as the highest priority of the potential destination port priority queue in the ship estimated arrival port matching model. By combining the shipping schedule data with AIS data, the destination port of the ship can be dynamically identified. On the basis of the historical records of the ship port call and AIS DEST matching records, the present invention performs the matching of the ship's potential destination port, and the ship dynamics and estimated arrival analysis to obtain the optimal matching destination port. The shipping schedule is the container company's schedule, which is usually the most accurate schedule. Therefore, it is placed in the first priority queue, and if the shipping schedule is matched, the process returns directly; if there is no shipping schedule, such as a container ship, the estimated arrival port is mainly determined based on the historical records of the ship port call and AIS DEST matching records. Combined with global container shipping schedule data, the present invention can more accurately obtain the container ship schedule estimated arrival port.

The present invention also relates to a system for identifying estimated arrival port of ship, the system corresponds to above-mentioned method for identifying estimated arrival port of ship, and can be understood as a system that implements the method for identifying estimated arrival port of ship. The system comprises a ship port call historical record module, an AIS DEST matching record module, and a ship estimated arrival port matching model construction processing module, which are

interconnected and work together. Preferably, the system uses shipping schedule data and AIS data to collect, clean, convert, analyze, model and perform optimal estimated arrival port matching, so as to realize the estimated arrival analysis of ships during the voyage, and realize shipping informatization and intelligence.

Description of the drawings

Figure 1 is a preferred flowchart of the method for identifying estimated arrival port of ship according to the present invention.

Figure 2 is a schematic diagram of a priority queue in the ship estimated arrival port matching model according to the present invention.

Figure 3 is a schematic diagram of another priority queue in the ship estimated arrival port matching model according to the present invention.

Figure 4 is a block diagram of the system for identifying estimated arrival port of ship according to the present invention.

Detailed description of embodiments

The present invention will be described below with reference to accompanying drawings.

The present invention relates to a method for identifying estimated arrival port of ship, the flowchart of which is shown in Figure 1, comprising:

(1) Based on the ship's AIS data, a dynamic of voyage segments of the ship is constructed, and historical records of the ship port call are established in this dynamic data. The historical records of ship port call can be understood as a data storage model. It can also be called a ship port call model, which reflects the behavior trajectory of the ship over a period of time. A typical ship port call history is the process of ship dynamics from 5 (berthing) to 5 (berthing). The present embodiment obtains AIS data for all ships starting from January 1, 2019. First, the ship segment dynamics are constructed, and the ship port call model is constructed in the dynamic.

The key fields of the model are: ship MMSI, ship name VESSEL_NAME, ship type VESSEL_TYPE, departure port START_PORT_CODE, port of call END_PORT_CODE, and number of calls LEG_TIMES.

(2) AIS DEST matching records are established based on the number of matches between the DEST information of the AIS of the ship and the ports of call of the voyage segments of the ship. The established AIS DEST matching records can also be understood as a data storage model, which can be called a AIS DEST identification model (or AIS DEST matching model), or a destination port identification model. In the last step, when the historical records of the ship port call was constructed, the AIS DEST matching records could be constructed according to AIS DEST in all voyage segments. According to the DEST and the ports of call END_PORT_CODE of the voyage segments, the number of matches, whether to confirm matches, and whether to correct them are determined.

The key fields of the model are: AIS destination port AIS_DEST, ship type VESSEL_TYPE, port of call END_PORT_CODE, number of matches of call MATCH_TIMES, and whether the match is confirmed IS_CONFIRM.

Further, further comprising AIS DEST cleaning of ship AIS data. The number of matches is determined according to the AIS DEST data of the ship with uniform standards after cleaning and the ports of call of the ship segments, so as to establish the AIS DEST matching records. Since there is no uniform standard for AIS in the filling process, DEST needs to be cleaned first in the pre-treatment stage. After cleaning, a more standard port English mark can generally be obtained. The AIS DEST cleaning procedures are:

- ◆ Taking data after the last character ">-", ">";
- ◆ Taking data before the data before the characters " ", "`", "#", "%", ";", "(", ",", ";
- ◆ Deleting more than 5 consecutive Bs in the character;
- ◆ Removing non-letter beginnings, non-letter endings and spaces;
- ◆ Returning null if the length is less than 2;
- ◆ Returning cleaned AIS_DEST_PURE.

(3) Current shipping schedule data is acquired. In order to be compatible with the estimated arrival port identification of all ships, this method integrates the shipping schedule data of container liners, which can be understood as a data storage model, which can also be called a shipping schedule model.

The shipping schedule data mainly includes ship name SHIP_NAME, ship MMSI, departure port START_PORT, destination port END_PORT_CODE, shipping company COMPANY, departure time START_TIME, estimated arrival time END_TIME. The shipping schedule data can include shipping schedule master storage data (or ship shipping schedule data) and port schedule data, that is, based on all current shipping schedule data, a shipping schedule master model and a port schedule model are established.

The key fields of the shipping schedule master model are: ship MMSI, ship shipping schedule number VOYAGE_NO, departure port START_PORT_CODE, destination port END_PORT_CODE, departure time START_TIME, and estimated arrival time END_TIME.

The key fields of the port schedule model are: ship shipping schedule model primary key PARENT_ID, port PORT_CODE, port name PORT_NAME, port schedule type SCHEDULE_TYPE.

(4) Based on the shipping schedule data, the historical records of the ship port call and the AIS DEST matching records, a ship estimated arrival port matching model is constructed. The ship estimated arrival port matching model has a potential destination port priority queue. The priority queue comprises:

√ If the destination port with the highest number of calls corresponding to the same origin port in the historical records of the ship port call is the same port as the

port with the highest number of calls in the AIS DEST matching records, the ship will return directly to the port;

- √ The port with same ship type and the highest number of matches in the AIS DEST matching records;

- √ The port without the same ship type, but with other ship type records and the highest number of matches in the AIS DEST matching records;

- √ The destination port with the highest number of calls corresponding to the same origin port in the historical records of the ship port call;

At the same time, the destination port of the container ship obtained by processing the matching logic on the shipping schedule data is used as the highest priority in the potential destination port priority queue in the ship estimated arrival port matching model; according to the optimal destination port of the matching result of the ship estimated arrival port matching model, the estimated arrival data of the ship's voyage is obtained. Considering matched optimal destination ports, the estimated arrival data of the ship's voyage is obtained. The ship's estimated arrival time and remaining mileage can be further analyzed to provide API services to others.

When matching with the destination port of the designated ship, the AIS information is entered. Firstly, the departure port `START_PORT_CODE` of the current segment of the ship is obtained based on the ship port call model. Then by cleaning the DEST in the ship AIS, the destination port `AIS_DEST_PURE` that needs to be matched is obtained. Then, based on the ship MMSI, departure port

START_PORT_CODE, and AIS_DEST_PURE, the priority queue of potential destination ports is obtained.

The constructed priority queue in the ship estimated arrival port matching model is not unique.

Example 1: As shown in Figure 2, in order of priority from highest to lowest, the priority queues comprises: the intersection of the historical records of the ship port call and the AIS DEST matching records, the AIS DEST destination port matched by the same ship type based on the AIS DEST matching records when the intersection is not obtained, the AIS DEST destination ports matched by different ship types based on the AIS DEST matching records when the intersection is not obtained, the number of calls at the destination port of the current original port segment base on the historical records of the ship port call when the intersection is not obtained, and the number of calls at the destination port of the current original port segment of all ships.

Example 2: As shown in Figure 3, in order of priority from highest to lowest, the priority queue comprises: the intersection of the historical records of the ship port call and the AIS DEST matching records, the number of calls at the destination port of the current original port segment based on the historical records of the ship port call when the intersection is not obtained, the AIS DEST destination ports matched by the same ship type based on the AIS DEST matching records when the intersection is not obtained, the AIS DEST destination port matched by different ship types based on the

AIS DEST matching records when the intersection is not obtained, and the number of calls at the destination port of the current original port segment of all ships.

Example 3: Taking into account the shipping schedule data, the destination port of the container ship obtained by processing the matching logic on the shipping schedule data is used as the highest priority in the potential destination port priority queue in the ship estimated arrival port matching model, as shown in Figures 2 and 3.

The present invention is specifically described below by an embodiment shown in FIG. 2.

According to the historical records of the ship port call and AIS DEST matching records, if the ship has ever had a segment record from the departure port to the AIS DEST after AIS cleaning, and the AIS DEST has been confirmed in the AIS DEST matching records, that is, the AIS DEST matching records and the historical records of ship port call have intersected, then this destination port will have a second priority 2.

In the case where there is no intersection between the AIS DEST matching records and the historical records of the ship port call, it may be that the AIS DEST is not accurate enough or dirty data, or the ship may have started a segment without a previous call history. The situation in which the ship has started a segment without call history will preferably be taken into account. According to the AIS DEST matching records, if the ships of same type have been matched with the AIS DEST destination ports, the destination ports with the higher matching times among these

matched destination ports can match the destination port in AIS more accurately. These destinations will have a medium priority 3.

If the ships of same type cannot match the AIS DEST destination, the AIS DEST destination ports that have been matched by ships of different type are selected. The destination ports with higher matching times among these matched destination ports can still match the destination port in AIS more accurately. These destinations will have a medium priority 4.

If the ships of same type and the ships of different type cannot match the AIS DEST destination port, only some destination ports that may not be accurately matched can be selected. The destination ports with the higher number of calls can be selected from the destination ports of the current departure port segment in the historical records of the ship port call. These destinations will have a lower priority 5.

If the ship does not has a history of call at any destination port from the current departure port, the destination port with the highest number of calls is selected from the destination ports of the current departure port segment of all ships. These destinations will have the lowest priority 6.

By combining all the destination ports with different priorities obtained in the above process, the destination port priority queue `p_potential_dest` based on the historical data of AIS can be obtained.

Further, the destination port based on the shipping schedule:

According to the shipping schedule model (shipping schedule data), a more accurate destination port of container ship can be obtained. When processing the matching logic in the shipping schedule model, the potential destination priority queue is obtained from the historical call records and AIS DEST matching records in the AIS historical data. If among these matched destination ports, there is a destination port for container ships, this destination port has the highest priority.

Destination port priority queue for estimated arrival port identification

The priority queue obtained based on AIS historical data and the priority queue obtained based on shipping schedule data are sorted according to priority and number of matches `match_priority`, and the top five or six destination ports are taken as the destination port priority queue for estimated arrival port identification.

The shipping schedule data, the historical records of the ship port call and the AIS DEST matching records of the present invention can be located in the underlying data platform. Through the above data model, the destination port identification can be realized. And on this basis, the platform can provide interfaces and model optimization for the upper structure, that is, a data logic processing platform. Preferably, by utilizing KETTLE to synchronize AIS data history data to the AIS data table, and adding logical judgment to the processing, the historical records of the ship port call and the AIS DEST matching records are constructed. By using KETTLE to synchronize shipping schedule data to shipping schedule table and port schedule table, the association of these two tables can obtain the shipping schedule data of container

ships. AIS data cleaning and preprocessing is the cleaning of destination port fields in AIS, including special characters and logical processing. The destination port matching and logical processing through the ship estimated arrival port matching model can be located on the logic processing platform. First, the shipping schedule data is obtained from the shipping schedule data platform. The potential destination priority queue of the ship is obtained from the historical records of the ship port call and the AIS DEST matching records. Considering the best of the matched destination ports, the estimated arrival data of the ship's voyage is obtained. The ship's estimated arrival time and remaining mileage can be further analyzed to provide API services to others. On the basis of the logic implementation of the lower layer, an API service platform (referred to as API platform) based on JAVA and SpringCloud microservice framework is provided externally, that is, the API platform that integrates destination port matching and estimated arrival analysis services. The destination port matching and estimating functions can be called from the API platform in the form of Restful interfaces to enable access to any platform, system, and mobile application. To implement iterative updates: After the actual occurrence of the ship call, the historical record of ship port call, the number of matches at the destination port, whether it matches and other parameters are updated.

The present invention relies on the historical AIS data of the ship, and constructs the historical records of the ship port call and AIS DEST matching records (or ship port call model and AIS DEST identification model) based on the AIS data. In

addition, in the present invention, the most important data in the realization of the destination port identification of container ships comes from the shipping schedule data of the container ships. The shipping schedule data of the container ships can more realistically reflect the estimated arrival ports of container ships. The shipping schedule model provides the estimated arrival port matching based on the ship's IMO.

The present invention also relates to a system for identifying estimated arrival port of ship. The system corresponds to above-mentioned method for identifying the estimated arrival port of ship. The system can be understood as a system that implements the method for identifying estimated arrival port of ship. As shown in Figure 4, the system comprises a ship port call historical record module, an AIS DEST matching record module, and a ship estimated arrival port matching model construction processing module, which are interconnected and work together. wherein, the ship port call historical record module, based on the ship's AIS data, constructs a dynamic of the shipping segments of the ship, and the historical records of the previous arrival ports of the ship are established in this dynamic. The AIS DEST matching record module establishes AIS DEST matching records based on the number of matches between the ship's AIS DEST data and the ports of call of the voyage segments of the ship. The ship estimated arrival port matching model construction processing module, based on the established historical records of the ship port call and the AIS DEST matching records, constructs the ship estimated arrival port matching model. The ship estimated arrival port matching model has a potential

destination port priority queue, wherein the priority queue comprises: the intersection of the historical records of the ship port call and the AIS DEST matching records, the AIS DEST destination ports matched by the same ship type in the AIS DEST matching records and the AIS DEST destination ports matched by different ship types in the AIS DEST matching records when the intersection is not obtained, and/or the number of calls at the destination port of the current departure port segment in the historical records of the ship port call when the intersection is not obtained; the estimated arrival data of the ship's voyage obtained according to the optimal destination port identified by the matching result of the ship estimated arrival port matching model.

Further, wherein the AIS DEST matching record module performs AIS DEST cleaning on the ship's AIS data, determines the number of matches according to the AIS DEST data of the ship with uniform standards after cleaning and the ports of call of the ship segments, so as to establish the AIS DEST matching records.

Further, wherein the system comprises a shipping schedule data module to obtain current shipping schedule data. The shipping schedule data module is connected to the ship estimated arrival port matching model construction processing module. At this time, the ship estimated arrival port matching model construction processing module constructs the ship estimated arrival port matching model according to the shipping schedule data, the historical records of the ship port call and AIS DEST matching records, and takes the destination port of the container ship obtained by performing

match logic on the shipping schedule data as the highest priority of the potential destination port priority queue in the ship estimated arrival port matching model.

Further, in order of priority from highest to lowest, the priority queue of the ship estimated arrival port matching module of the ship estimated arrival port matching model construction processing module comprises: the intersection of the historical records of the ship port call and the AIS DEST matching records, the AIS DEST destination ports matched by the same ship type in the AIS DEST matching records when the intersection is not obtained, the AIS DEST destination ports matched by different ship types in the AIS DEST matching records when the intersection is not obtained, the number of calls at the destination port of the current departure port segment in the historical records of the ship port call when the intersection is not obtained, and the number of calls at the destination port of the current departure port segment of all ships.

Or comprises: the intersection of the historical records of the ship port call and the AIS DEST matching records, the number of calls at the destination port of the current departure port segment in the historical records of the ship port call when the intersection is not obtained, the AIS DEST destination ports matched by the same ship type in the AIS DEST matching records when the intersection is not obtained, the AIS DEST destination ports matched by different ship types in the AIS DEST matching records when the intersection is not obtained, and the number of calls at the destination port of the current departure port segment of all ships.

The system for identifying the estimated arrival port of ship according to the present invention mainly comprises two functions: destination port matching, API service.

Destination port matching is a core of this solution, that is, based on AIS information, the estimated arrival port identification priority queue based on the shipping schedule data, the AIS call history records and the AIS DEST matching records is obtained through logical processing.

API service, obtains the ship estimated arrival port identification priority queue according to the departure port and destination port, logically selects such as ship estimated arrival time, remaining sailing mileage and other ship dynamic data, provides external API interface for querying the ship's current estimated arrival port, estimated arrival time, and shipping schedule arrival time according to the ship MMSI.

The method and system for identifying estimated arrival port of ship according to the present invention have higher feasibility and accuracy than the prior art. Combined with the global container shipping schedule data, the present invention can more accurately obtain the container ship schedule estimated arrival port. Combined with the historical records of the ship port call and AIS DEST matching records, when the destination port is unclear or ambiguous in the AIS data, the present invention can better reflect the ship's real destination port. The established historical records of the ship port call and AIS DEST matching records, as well as the constructed ship

estimated arrival port matching model, will optimize the model parameters after the ship berths. As the amount of data increases and the number of matches increases, the correct match rate will continue to increase.

It should be noted that above-described embodiments may make those skilled in the art more fully understand the present invention, but do not limit the present invention in any way. Therefore, although the present specification has been described in detail with reference to the accompanying drawings and embodiments, it should be understood by those skilled in the art that the invention can still be modified or equivalently replaced. In short, all technical solutions and improvements that do not deviate from the spirit and scope of the present invention shall all be covered by protection scope of the present patent.

Claims

1. A method for identifying estimated arrival port of ship, comprising following steps:

based on the ship's AIS data, constructing a dynamic of voyage segments of the ship, and establishing historical records of the ship port call by using this dynamic;

establishing AIS DEST matching records, in reverse order according to the number of matches, according to the AIS DEST records of the ship and the final ports of call of the corresponding ship;

based on the established historical records of the ship port call and the AIS DEST matching records, constructing a ship estimated arrival port matching model, the ship estimated arrival port matching model has a potential destination port priority queue, wherein the priority queue comprises: an intersection of the historical records of the ship port call and the AIS DEST matching records, AIS DEST destination ports matched by same ship type based on the AIS DEST matching records and AIS DEST destination ports matched by different ship types based on the AIS DEST matching records when the intersection is not obtained, and/or the number of calls at the destination port of the current original port segment based on the historical records of the ship port call when the intersection is not obtained; estimated arrival data of the ship's voyage obtained according to the optimal destination port identified by matching result of the ship estimated arrival port matching model.

2. The method for identifying estimated arrival port of ship according to claim 1, wherein, in order of priority from highest to lowest, the priority queue of the constructed ship estimated arrival port matching model comprises: the intersection of the historical records of the ship port call and the AIS DEST matching records, the AIS DEST destination ports matched by same ship type based on the AIS DEST matching records when the intersection is not obtained, the AIS DEST destination ports matched by different ship types based on the AIS DEST matching records when the intersection is not obtained, the number of calls at the destination port of the current original port segment based on the historical records of the ship port call when the intersection is not obtained, and the number of calls at the destination port of the current original port segment of all ships.

3. The method for identifying estimated arrival port of ship according to claim 1, wherein, in order of priority from highest to lowest, the priority queue of the constructed ship estimated arrival port matching model comprises: the intersection of the historical records of the ship port call and the AIS DEST matching records, the number of calls at the destination port of the current original port segment based on the historical records of the ship port call when the intersection is not obtained, the AIS DEST destination ports matched by same ship type based on the AIS DEST matching records when the intersection is not obtained, the AIS DEST destination ports matched by different ship types based on the AIS DEST matching records when

the intersection is not obtained, and the number of calls at the destination port of the current original port segment of all ships.

4. The method for identifying estimated arrival port of ship according to any of claims 1-3, further comprising a step of obtaining current shipping schedule data, constructing the ship estimated arrival port matching model based on the shipping schedule data, the historical records of the ship port call and AIS DEST matching records, and taking the destination port of the container ship obtained by performing match logic on the shipping schedule data as the highest priority of the potential destination port priority queue in the ship estimated arrival port matching model.

5. The method for identifying estimated arrival port of ship according to any of claims 1-3, further comprising AIS DEST cleaning of ship AIS data, the number of matches is determined according to the AIS DEST data of the ship with uniform standards after cleaning and the ports of call of the ship segments, so as to establish the AIS DEST matching records.

6. The method for identifying estimated arrival port of ship according to any of claims 1-3, wherein considering matched optimal destination port, the estimated arrival data of the ship's voyage is obtained, the ship's estimated arrival time and remaining mileage can be further analyzed to provide API services to others.

7. A system for identifying estimated arrival port of ship, comprising a ship port call historical record module, an AIS DEST matching record module, and a ship

estimated arrival port matching model construction processing module which are interconnected,

the ship port call historical record module, based on the ship's AIS data, constructs a dynamic of voyage segments of the ship, and historical records of the ship port call are established in this dynamic;

the AIS DEST matching record module forms mapping relationships according to ship's AIS DEST records and the corresponding ship's final port of call and arranges the mapping relationships according to the number of matches, so as to establish AIS DEST matching records;

the ship estimated arrival port matching model construction processing module, based on the established historical records of the ship port call and the AIS DEST matching records, constructs a ship estimated arrival port matching model, the ship estimated arrival port matching model has a potential destination port priority queue, wherein the priority queue comprises: an intersection of the historical records of the ship port call and the AIS DEST matching records, AIS DEST destination ports matched by same ship type based on the AIS DEST matching records and AIS DEST destination ports matched by different ship types based on the AIS DEST matching records when the intersection is not obtained, and/or the number of calls at the destination port of the current original port segment based on the historical record of the ship port call when the intersection is not obtained; estimated arrival data of the

ship's voyage obtained according to the optimal destination port identified by matching result of the ship estimated arrival port matching model.

8. The system for identifying estimated arrival port of ship according to claim 7, wherein the AIS DEST matching record module performs AIS DEST cleaning on the ship AIS data, determines the number of matches according to the AIS DEST data of the ship with uniform standards after cleaning and the ports of call of the ship segments, so as to establish the AIS DEST matching records.

9. The system for identifying estimated arrival port of ship according to claim 7 or 8, further comprising a shipping schedule data module to obtain current shipping schedule data, the shipping schedule data module is connected to the ship estimated arrival port matching model construction processing module; at this time, the ship estimated arrival port matching model construction processing module constructs the ship estimated arrival port matching model based on the shipping schedule data, the historical records of the ship port call and AIS DEST matching records, and takes the destination port of the container ship obtained by performing match logic on the shipping schedule data as the highest priority of the potential destination port priority queue in the ship estimated arrival port matching model.

10. The system for identifying estimated arrival port of ship according to claim 9, wherein the ship estimated arrival port matching model construction processing module, in order of priority from highest to lowest, the priority queue of the constructed ship estimated arrival port matching model comprises: the intersection of

the historical records of the ship port call and the AIS DEST matching records, the AIS DEST destination ports matched by same ship type based on the AIS DEST matching records when the intersection is not obtained, the AIS DEST destination ports matched by different ship types based on the AIS DEST matching records when the intersection is not obtained, the number of calls at the destination port of the current original port segment based on the historical records of the ship port call when the intersection is not obtained, and the number of calls at the destination port of the current original port segment of all ships;

or comprises: the intersection of the historical records of the ship port call and the AIS DEST matching records, the number of calls at the destination port of the current original port segment based on the historical records of the ship port call when the intersection is not obtained, the AIS DEST destination ports matched by same ship type based on the AIS DEST matching records when the intersection is not obtained, the AIS DEST destination ports matched by different ship types based on the AIS DEST matching records when the intersection is not obtained, and the number of calls at the destination port of the current original port segment of all ships.