Water Transportation

Contents

Impacts of Pollution Emissions on Arctic Routes

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Abstract：In order to investigate the navigable distribution of vessels on arctic routes (i.e. Northwest Passage and Northern Sea Route) and analyse impacts of pollution emissions on arctic routes, this paper uses Automated Identification System (AIS) data and vessel characteristic data to analyse the navigable situation of vessels on arctic routes from 2012 to 2016. Combined the two sets of data with the bottom-up pollution emission model, the pollution from vessels along arctic routes is quantitatively analysed. The analysis shows that, with the enhancement of arctic navigation capacity, the pollution emissions from ships along arctic routes increased and that the largest emitters of all ship types are Tankers, Cargos and others. This paper further analyses the emissions along arctic routes when sulfur policy changes in 2020. This investigation is a supplement to the literature on analysis of arctic pollution emission inventory.

Key words：arctic shipping

基于船舶模拟实验的航道通航安全评估

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摘　要：简要论述了运用船舶模拟器进行仿真模拟试验在通航安全评估中的的必要性，罗列了应用船舶模拟器进行通航安全评估的一般步骤。在结合实例的基础上，应用模拟试验的方法对航道扩能工程设计方案进行了验证，对模拟结果进行了分析和评价；最后简要概述了运用船舶模拟器进行安全评估的优势。

关键词：航道扩能

Navigation Safety Assessment Based on Ship Simulation Experiment

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Abstract：

The necessity of using ship simulator to carry out simulation test in navigation safety assessment is briefly discussed. The general steps of applying ship simulator for navigation safety assessment are listed. On the basis of the combined examples, the simulation test method was applied to verify the design of the channel expansion project, and the simulation results were analyzed and evaluated. Finally, the advantages of using the ship simulator for safety assessment were briefly summarized.

keywords: channel expansion

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大型船舶抵泊横距计算方法研究

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摘　要：国内码头前沿水域抵泊横距的设计中，主要是依据交通部颁布的《海港总平面设计规范》（JTS165-2013）（以下简称"规范"）[1]中对码头前沿水域抵泊横距的设定，即 2 倍的船宽。但规范中对码头前沿水域宽度的设计是基于《港口工程设计手册》中对天津港 9 艘 10000T-13000T 海轮（在风速小于 6 级、纵向水流小于 1kn 的条件下）的实测数据。随着船舶大型化的发展、船舶操纵性的提升以及在风速大于 6 级风条件下靠泊等因素。原有的规范值已经无法符合实际操作所需的水域宽度。因此，本文尝试通过对码头前沿水域的深入分析，研究码头前沿水域抵泊横距的计算方法。

关键词：海港；码头前沿水域；抵泊横距

Study on Calculation Method of the Large Ship's Berthing Distance

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Abstract：

　　In the design of the frontal waterfront landing distance of the domestic terminal, it is mainly based on the "Overall Design Code For Sea Ports" (JTS165-2013) (hereinafter referred to as "Specification") issued by the Ministry of Communications. The setting is 2 times the width of the ship. However, the design of the width of the forefront of the wharf in the specification is based on the measured data of nine 10000T-13000T seagoing vessels in Tianjin Port (with wind speed less than 6 and the current less than 1kn). With the development of large-scale ships, the improvement of ship maneuverability and the berthing of wind speeds greater than 6 wind conditions. The original specification value has been unable to meet the water width required for actual operation. Therefore, this paper attempts to study the calculation method of the landing distance of the forefront waters of the wharf through deep analysis of the waters at the forefront of the wharf..

keywords: seaport; Front waters of the pier; berthing distance

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对遇局面下船行波的数值仿真研究

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摘　要：船行波大小直接影响到两船对遇情况下船舶的操纵性，基于 CFD 技术，采用 RANS 数值方法、VOF 多相流模型和 6DOF 运动学模型等物理学模型，模拟分析了内河浅水水域两船对遇情况下波态以及船行波对两船船体和岸堤的影响。通过数值计算和仿真发现船行波对小型船舶两船对遇时船间作用干扰明显，船行波波高增加明显，响应逼真。可供研究、设计部门参考。

关键词：内河；浅水水域；对遇；船行波；数值模拟

Numerical Simulation Study of the Ship's Wave in the Case of Head on Situation

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Abstract：

The size of the ship's traveling wave directly affects the maneuverability of the ship under the condition of Head on situation. Based on CFD technology, the physics model such as RANS numerical method, VOF multiphase flow model and 6DOF kinematics model are used to simulate and analyze the two pairs of inland shallow waters. In the case of the situation, the wave state and the effect of the ship's traveling wave on the hull and bank of the two ships. Through numerical calculation and simulation, it is found that the ship's traveling wave has obvious interference to the ship-to-ship interaction between the two ships, and the wave height of the ship increases obviously and the response is realistic. It can be used as a reference for research and design departments.

keywords: inland rivers; shallow waters; ship's meeting; ship wave; numerical simulation

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长三角 ECA 区域实施对上海港口部分船舶营运影响分析

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摘 要：长三角排放控制区（Emission Control Zone，ECA）的建立对国家战略和上海发展均起到重要的作用，然而，排放区的建立对上海环境、经济及船舶营运等方面产生多大的影响，需要进一步研究。通过建立算法模型，结合上海相关港口部分船舶 AIS 数据，对 ECA 实施前后上海港口营运及成本进行分析。分析结果表明，在实施长三角 ECA 区域后，在排放气体含硫量、含碳量降低的同时，经济并没有受到损失。该模型对 ECA 区域实施对上海经济发展具有较好的预测作用，也说明 ECA 战略的前瞻性和正确性。

关键词：排放控制区；经济；航迹预测；船舶营运

Analysis of the Impact of ECA Regional Implementation in Yangtze River Delta on the Operation of the Ship in Shanghai Port

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Abstract：

The establishment of the Yangtze River Delta Emission Control Zone (ECA) plays an important role in the national strategy and the development of Shanghai. However, how much impact the establishment of the ECA has on Shanghai's environment, economy and ship operation needs further study. Based on the algorithm model and AIS data of some ships in Shanghai's relevant ports, the operation and cost of Shanghai's ports before and after the implementation of ECA are analyzed. The results show that after the implementation of the Yangtze River Delta ECA region, the economy has not suffered losses while the sulfur content and carbon content of the emission gases have been reduced. This model has a good predictive effect on the economic development of Shanghai, and also shows the foresight and correctness of the ECA strategy.

keywords: emission control zone; economics; track prediction; ship operation

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浙江省内河骨干航道液化天然气（LNG）加注码头布局研究

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摘　要： 现阶段，内河液化天然气（以下简称 LNG）加注码头的发展在我国尚处于起步阶段，在浙江省及我国大部分省市建设还处于空白。研究者分析了我国及浙江省现有 LNG 加注码头建设和运营的现状，总结存在的主要问题，提出 LNG 加注码头布局的思路，深入研究布置模式，研究得出浙江省 LNG 加注码头的布局方案，研究结论具有较强的适用性、推广性。

关键词： 液化天然气（LNG）；加注码头；内河骨干航道；布置模式。

Study on the Layout of Liquefied Natural Gas (LNG) Filling Wharf for Inland River Trunk Channel in Zhejiang Province

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Abstract：

　　At present,The development of chinese inland liquefied natural gas (LNG) filling wharf is still in Initial stage, its construction of zhejiang and other provinces in China is In blank. Researchers analyzed the current situation of construction and operation of LNG filling wharf in China and Zhejiang Province, and summaried the main existing problems. Proposed the principles and ideas of distribution of LNG filling wharf, and studied the distribution mode In depth to get the plan. The research conclusion has strong applicability and generalization.

keywords: liquefied natural gas(LNG); filling wharf; main inland waterway;distribution mode

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"IRONGATE"轮过关门海峡航法

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摘　要：位于日本列岛西段的关门海峡是中国北部港口、韩国、朝鲜通往日本东部的重要水道。往来船舶选择关门海峡航线比大隅海峡航线可节约航程约 230 海里，一艘主机功率 3 000 千瓦、航速 15 节左右的船舶，选择关门海峡航线可节约燃油 30t 左右[1]。但海峡水道狭窄、弯曲、潮流流速较大，且其内船舶流通量大、交通态势复杂，这造成了本地区海事事故多发。本文通过对海峡的地理环境、水文气象、报告制度、导航设施和海峡内航行时一些注意事项的介绍，同时结合良好船艺及船舶多次通过海峡的经历，谈一下我船过关门海峡的体会，提出一些过海峡时的值班瞭望、船舶定位和事故预防的建议，总结出一些同类型船舶依照导航设施（浮标、叠标等）东行通过海峡的航法。

关键词：关门海峡；导航设施；航行方法

MV IROGATE Sailing Method Through the Kammon-Kaikyo

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Abstract：

　　Located in the western part of the Japan, the Kammon strait is a very important waterway connecting the SetoNaikai of Japan which connecting the Pacific Ocean, the northern ports of China, South Korea, and North Korea to the eastern parts of Japan. The vessel choice of Kammon-kaikyo Passage rather than Osumi-kaikyo Passage can save about 230 nautical miles, a host power 3 000 kilowatt, the speed around of 15 knots vessel, choose the Kammon-kaikyo Route can save fuel oil around 30 Tons[1]. But the traffic of vessel is heavy and complex, and its channel is relatively narrow, curved, tidal flow is very strong, which caused many maritime accidents.

This paper through the introduction of the Straits geographical environment, hydrology meteorology, the report system, the navigation facility ,some other things need pay special attention，at the same time along with the good seamanship and the experience of the ship passed through the Strait, talks about the way my ship pass the Kammon-kaikyo, put forward some proposal of the lookout, position fix and preventions of accidents, and summarizes some navigation advices for other similar type ships passes through the channel form west to east by the aids to navigation(buoys, leading lights).

keywords: Kammon-kaikyo; aids to navigation; navigation

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基于非等时距时序残差 ARIMA 模型的船舶行为预测

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摘　要： 根据船舶驾驶时预知他船位置和会遇位置的需求，以及 VTS 对重要船舶行为预测的需求，提出非等时距时序残差 ARIMA 模型的船舶行为预测方法。根据时间序列分析的原理，构造船舶行为特征分析和预测的模型，以船舶航迹数据中的船舶行为特征值作为输入，对船舶未来的行为进行预测。并以洋山港深水航道内 AIS 船舶航迹数据进行试验，结果表明：该方法对船舶行为预测的较准确，误差在可接受范围内。

关键词： 水路运输；船舶行为；预测；ARIMA；残差；非等时距时序

Prediction of Vessel Behavior with Non-Equidistant Time Series and Residual Error ARIMA Model

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Abstract：

According to the need to predict the vessels'position and the encounter position during sailing, as well as the need of VTS to predict the behavior of important vessels, author proposes a vessel behavior prediction method based on non-equidistant time series and residual error ARIMA model. According to the principle of time series analysis, the characteristic value of vessels behavior in track data is used as input to predict the future behavior of vessels. Use the AIS vessel track data in the deep water fairway of Yangshan port for test, the result shows that the method is accurate and the error is within acceptable range.

keywords: waterway transportation;vessel behavior;prediction;ARIMA;residual error; non-equidistant time series

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海上小目标 SAR 图像清晰化算法研究

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摘　要： 合成孔径雷达（SAR）不仅拥有一般雷达远距离、全天时、全天候工作的优点，而且具有高分辨率的特点。目前国内外都使用 SAR 做为海上小目标检测应用的重要技术手段，然而海上小目标的检测一直是海上目标检测领域急需解决的难题，很大一部分问题在于海上小目标的 SAR 图像不够清晰。海上慢速弱小目标具有高度低、速度慢、雷达反射横截面积小等特点。针对该问题，本文提出了小波多尺度变换，用来增强小目标雷达图像的信杂比，解决了目标与背景杂波对比度低的问题，SAR 图像会变得清晰，然后使用 CFAR 算法完成对弱小目标的检测，最后对实验结果进行分析得出相关结论。

关键词： 小波变换；多尺度；SAR 图像

Research on the Algorithm of SAR Image Sharpening for Small Targets at Sea

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Abstract：

Synthetic Aperture Radar (SAR) not only has the advantages of long range, all day, all weather operation, but also has the characteristics of high resolution. At present, SAR is used as an important technical means to detect small targets at sea. However, detection of small targets at sea has always been a difficult problem in the field of marine target detection. A large part of the problem is that the SAR images of small targets at sea are not clear enough. Low altitude, low speed and small cross-sectional area of radar are the characteristics of low-speed small target at sea. In order to solve this problem, wavelet multiscale transform is proposed to enhance the signal-to-clutter ratio and solution of small target radar images. After solving the problem of low contrast between target and background clutter, the SAR image will become clear, and then CFAR algorithm will be used to detect small and weak targets. Finally, the experimental results are analyzed and the relevant conclusions are obtained.

keywords: wavelet transform; Multi-scale; SAR image

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A Ship Model Considering Communication in Ice-Covered Water

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Abstract： The development of wireless communication technology has brought new technical means to maritime transportation. In this study, a new ship fleet following model that considered Internet of Vessels (IoV) is constructed under the condition of ice-covered waters. The final proposed model represents the following behaviour of the network ship. Then, the paper derives the following model for the fleet navigation led by icebreaker through the analysis of the linear stability of the model. Simulations and analysis reveal that stability is improved compared to the situation without considering communication and the backward-looking effect. The model can be used for the theoretical basis of simulation software and simulation of ship actual operation. Moreover, it can accurately predict the change of the velocity in the ship following behaviour. Consequently, the improved stability of the proposed following model will reduce the risk of collisions of fleet navigation in ice-covered waters.

Key words： Internet of Vessels; Following model; Icebreaker; Harsh environment; Maritime transportation

船舶装载重大件货物监督管理研究

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摘　要： 随着现代工业的发展，重大件货物的运输需求越来越高，但由于重大件货物运输技术不到位、缺乏运输经验、监管不完善等诸多原因，使得船损货损的事故频发。因此，本文通过综述相关国际公约，结合教学实习船"育鹏"轮简述船舶在装载和运输重大件货物时监督管理过程，并对其进行相关的研究和探讨，同时给出一些货物监督管理方面的意见和措施，以期给其他船舶提供参考。

关键词： 重大件货物；装卸；监督管理

Research on Supervision and Management of Ships Loading Wakward or Lengthy Cargo

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Abstract：

　　With the development of modern industry, the transportation demand of wakward or lengthy cargo is getting more and more. However, because of the lack of transportation technology, lack of transportation experience, imperfect supervision and so on, the accidents of ship damage and goods damage are frequent. Therefore, by summarizing relevant international conventions and combining with the teaching practice vessel "Yu Peng", this paper describes the supervision and management process of ships when loading and transporting wakward or lengthy cargo, and carries out relevant research and discussion on them, at the same time gives some suggestions and measures on the supervision and management of goods in order to provide reference for other ships.

keywords: wakward or lengthy cargo; loading and unloading; supervision and management

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基于指数收敛非线性干扰观测器的动力定位滑模控制

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摘　要：为了解决具有非线性和环境干扰的船舶动力定位系统的控制问题，本文提出了一种基于基于指数收敛非线性干扰观测器的滑模控制算法，证明了闭环系统的稳定性。通过切换函数的设计，对不确定性和外加干扰具有较强的鲁棒性，避免系统出现抖振现象。对基于线性矩阵不等式的滑模控制器进行仿真，计算出动力定位船舶在有外界环境扰动的变速运动情况下的前进位置、横荡位置、艏向角度、前进速度、横荡速度、艏向角速度、前进控制力、横荡控制力和艏向控制力矩等。对滑模面增益 c、控制率增益 K 等参数对控制性能的影响进行了比较分析。结果表明，所设计的控制器对有非线性和环境干扰的船舶动力定位系统都具有较强的鲁棒性。本算法为不确定性系统的变结构控制提供了新的解决方案，扩展了滑模控制算法的应用领域，同时为有效解决船舶动力定位问题提供了科学依据。

关键词：dynamic positioning; neural network; fractional calculus; 动力定位；滑模控制；观测器

Fractional Order Adaptive Sliding Mode Control Based on Neural Network for Dynamic Positioning Ship

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Abstract：

In order to solve the control problems of dynamic positioning system with nonlinear and environment al disturbance, an adaptive sliding mode control based on exponential convergence nonlinear disturbance observer is proposed in this paper, and the stability of closed-loop system is proved. The robustness to external disturbances and uncertainty is obtained by the design of switching function, and the chattering phenomenon in the system is avoided. The sliding mode controller is simulated. The forward position, sway position, yaw angular, forward speed, sway velocity, yaw angular velocity, heading forward input control, sway input control and yaw control torque of dynamic positioning ship are computed in the variable motion with disturbance. The influence of parameters such as sliding surface gain c and control rate gain K on the control effect are compared and analysed. The results show that the designed controller has strong robustness to the ship dynamic positioning system with nonlinear and environmental disturbance. This algorithm provides a new solution for variable structure control of uncertain systems, and extends the application field of sliding mode control algorithm. At the same time, it provides a scientific basis for solving the ship dynamic positioning problem effectively.

keywords: dynamic positioning; sliding mode control; observer

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一种面向受限水域的无人艇路径规划方法

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摘　要： 针对传统 A*算法搜索时出现搜索过的节点不再被其搜索，从而造成在受限水域环境下搜索不到路径的问题，提出一种面向受限水域的无人艇路径规划方法。首先，建立无人艇的路径规划所需的规划空间；其次，构建高维 A*搜索算法，在原来 A*搜索算法基础上增加一个方向搜索维度为三维节点搜索，从而实现在路径搜索过程中被二维节点搜索过的节点可以在三维节点搜索时重复搜索；最后，建立无人艇轨迹单元库，结合轨迹单元和高维 A*算法，实现考虑无人艇动力学与控制结合下的无人艇路径规划。经过实验得出，本方法不仅可以在一定程度上避免无人艇路径规划陷入局部最优，而且与基于 A*算法的无人艇运动规划方法相比，在狭长水域和复杂岛礁环境下仍然可实现较优的无人艇运动规划。

关键词： 无人艇；路径规划；高维 A*算法；受限水域

Unmanned Surface Vehicle Path Planning Method for Restricted Waters

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（Wuhan University of Technology）

Abstract：

Aiming at the problem that the searched nodes in the search of traditional a* algorithm are no longer searched, which results in the local optimization of the path and the failure to search the path in complex environment, an unmanned surface vehicle(USV) path planning method based on the high-dimensional a* algorithm is proposed. Firstly, the planning space needed for the path planning of USVs is established, and secondly, the a* algorithm is improved to increase one direction search dimension, so that the node which was searched by two-dimensional nodes in the process of path search can repeat the search when searching in three-dimensional nodes, and then realize that the path of traditional a* search can be re-searched, and finally, the establishment of USV trajectory Unit library, combined with trajectory unit and improved a* algorithm, Realization of the knot considering the dynamics and control of USVs. It is proved by experiments that this method can not only avoid the local optimization of USV path planning to a certain extent, but also realize the better USV path planning in the narrow waters and complex reef environment compared with the traditional a* USV path planning method.

keywords: unmanned surface vehicle; path planning; high dimensional A* algorithm; restricted waters

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汽渡轮航向控制算法及其仿真研究

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摘　要：本文针对汽渡轮避让操船对不同初始舵角的航向控制算法适应性需求，基于汽渡轮 KT 响应模型，运用模糊自整定 PID(比例-积分-微分)航向控制算法，根据 PID 初始值与 KT 的关系以及航向偏差二阶系统阻尼系数对控制性能的影响，借助 MATLAB 的仿真测试，采用加权综合评判法，获取不同舵角及改向角的最佳阻尼系数ζ。研究结果分析表明，阻尼系数随汽渡轮舵角的增大而增大，其变化规律合理。该结果可为确定适应性良好的航向自动控制算法提供方向上的指引。

关键词：阻尼系数；取值规律；模糊自整定；PID 初始值；汽渡轮

Study on the Law of Damping Coefficient Selection for Automatic Control Algorithm of Steam Ferry

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Abstract：

The paper is aimed at the adaptability requirement of different initial rudder angle for steam ferry collision avoidance , which based on the corresponding KT model of steam ferry, the fuzzy self-tuning PID (Proportion - Integral - Derivative) algorithm is used to control the course., and according to the relationship between the initial value of PID and K,T and the influence of the damping coefficient of the second-order system of course deviation on the control performance, meanwhile in order to obtain optimum damping coefficient of different rudder angles and steering angles, this paper also uses simulation test with MATLAB and adopts weighted comprehensive evaluation method. The results show that the damping coefficient increases with the increase of the rudder angle, and the variation law is reasonable.The experimental results can provide direction and guidance for the determination of adaptive automatic course control algorithm.

keywords: damping coefficient; value rule; fuzzy self-tuning; PID initial value; steam ferry

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Performance Modelling of a Ship Hull Subject to Biofouling

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Abstract： During the operation of a ship, marine microorganisms, plants, and animals will grow on the immersed surface of the hull. This undesirable accumulation of marine organisms is termed as biofouling. An adverse effect of biofouling is increasing the hull's frictional resistance. Consequently, excess fuel will be consumed in order to maintain service speeds, which also results in huge volume of greenhouse gas emissions. To combat biofouling, hulls are equipped with antifouling paints. However, aggressive biofouling still might develop on the immersed hull due to high fouling pressure. Hull cleanings can mitigate the effects of biofouling, yet at the same time, they incur not only the cost of the service itself, but also off-hire cost due to the vessel not being able to trade during the cleaning. In consequence, how to schedule hull cleanings during the lifecycle of a paint to minimize the cost incurred by biofouling has become an issue of great concern to ship owners. To address this problem, we first build a grey-box model (GBM) to evaluate biofouling effects for different sailing profiles based on historical data, in which major factors that affect the accumulation of biofouling will be involved. Secondly, we develop a cost minimization model to determine the optimal time schedule of hull cleanings for a new paint, in which the biofouling effects are predicted based on the above GBM and prescribed sailing pattern. The obtained result would be a good guidance for maintenance customized to individual ship, better than a general 'rule-of-thumb' conventionally used in shipping companies.

Key words： ship performance; hull cleaning; biofouling; grey-box model

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超大型船舶富裕水深影响机理及影响因素辨识研究

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（长江海事局 武汉市武昌区建设局）

摘　要：运用系统论方法，从"人-机-环境"对超大型船舶富裕水深影响因素分类，分析富裕水深影响机理。运用 ISM 模型开展影响因子辨识，构建了 5 级影响因子递阶系统。根据数据计算分析，按照影响大小提炼出超大型船舶富裕水深一级影响因子 6 个、二级影响因子 4 个、三级影响因子 2 个、四级影响因子 4 个、五级影响因子 3 个，为超大型船舶富裕水深研究和安全航行提供基础支撑。

关键词：超大型船舶；富裕水深；影响因素辨识；ISM 模型

Research on Influencing Mechanism and Identification of Under Keel Clearance for Very Large Crude Carrier

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Abstract：

In order to analyze the influencing mechanism of under keel clearance, this paper classifies the influencing factors from the perspective of "man-machine-environment" by using the system theory. The ISM model is proposed for identify the impact factors, the hierarchical system with 5 levels for impact factors is constructed. According to the calculation analysis, 6 first-order influence factors, 4 second-order influence factors, 2 third-order influence factors, 4 fourth-order influence factors and 3 fifth-order influence factors are extracted according to the influence effect, it provides basic support for the study on under keel clearance and safe navigation for Very Large Crude Carrier.

keywords: Very Large Crude Carrier; under keel clearance; impact factor identification; ISM model

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长江高能耗高污染船舶评价体系研究

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摘　要：在充分梳理国内外船舶环保技术标准的基础上，从能耗和污染两方面入手建立了长江高能耗高污染船舶评价体系，并划定了高能耗、高污染船舶评价指标的阈值，实现了长江现有船舶能耗和污染水平的分级分类，提供了一种能够识别高能耗高污染船舶的有效途径，从而能够有针对性的提出管控长江高能耗高污染船舶的对策建议，为行业评价和鉴定高能耗、高污染船舶提供可操作性实用方法。

关键词：船舶能耗；船舶污染；评价体系；对策建议

Study on Evaluation System of Ships with High Energy Consumption and Pollution in the Yangtze River

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Abstract：

On the basis of thoroughly combing the technical standards of ship environmental protection at home and abroad, the evaluation system of high energy consumption and high pollution ships in the Yangtze River has been established from two aspects of energy consumption and pollution, and the threshold of evaluation index of high energy consumption and high pollution ships has been delineated. The classification of energy consumption and pollution levels of existing ships in the Yangtze River has been realized, which provides an effective way to identify high energy consumption and high pollution ships. Therefore, the countermeasures and suggestions for the management and control of high energy consumption and high pollution ships in the Yangtze River can be put forward, which can provide operational and practical methods for industry evaluation and identification of high energy consumption and high pollution ships.

keywords:ship energy consumption;ship pollution;evaluation system;countermeasures and suggestions

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沉管水下调整运动轨迹与受力分析

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摘　要：本文结合国内外沉管水下纠偏施工技术的基础上，依托港珠澳大桥沉管隧道现场复杂海况的施工条件，采用解析计算、数值模拟计算及物模试验相结合的方法，研究分析了 8 万吨重沉管在深水条件下，隧道管节水下轴线调整过程中的受力规律，通过综合分析得出了沉管水下轴线纠偏过程中的运动和受力规律，得出了沉管在纠偏过程中沉管的运行轨迹，并找出了沉管初始启动运动力学旋转点位置的计算方法，综合上述的研究成果，开发了沉管水下精确调整的设备及方法，并通过工程应用进行了应用验证，与成果研究相似，为沉管水下精确调整和设备配置提供施工和设计的技术依据。

关键词：沉管；水下调整；力学模型；运动规律；旋转点

Analysis of Underwater Moving Trajectory and Force of Immersed Pipe

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Abstract：

Based on the underwater deviation rectification construction technology of immersed pipe at home and abroad, relying on the construction conditions of immersed pipe tunnel of Hong Kong-Zhuhai-Macao Bridge under complex sea conditions, this paper studies and analyses the adjustment process of axis of immersed pipe with 80,000 tons weight under deep water condition and water saving by means of analytical calculation, numerical simulation and physical model test. Through comprehensive analysis, the movement and force law of the immersed tube in the course of underwater axis correction are obtained, the running track of the immersed tube in the course of deviation correction is obtained, and the calculation method of the rotating point position of the immersed tube's initial starting motion mechanics is found. Based on the above research results, the underwater precision of the immersed tube is developed. The equipment and method of adjustment are verified by engineering application, which is similar to the results of research. It provides technical basis for construction and design of underwater precise adjustment and equipment configuration of immersed pipe.

keywords: immersed pipe; underwater adjustment; mechanical model; motion law; rotating point

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Inspection Area Layout Optimization at Foreign Trade Container Terminal Considering Uncertainties

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Abstract：The conventional approach of container terminal land area layout should be re-examined against the background of sustainable development. For the security of ports and container shipping industry, a key problem for a foreign trade container terminal is the planning and design of the inspection area. Considering the uncertain inspection demand, a simulation-based optimization model is proposed to obtain a cost-effective and reliable layout solution to the site selection and inspection facility deployment strategy of the inspection area at a foreign trade container terminal. A real-world terminal is chosen to do a case study and the results show that the proposed integrated decision model as well as solution method is effective and helpful for optimizing inspection area layout in the context of sustainable port development.

Key words：foreign trade container terminal;inspection area;layout optimization; uncertainty

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Precise Navigation Using Multi-Source Information Based on Resilient PNT Model

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Abstract：The Beidou Navigation Satellite System (BDS) provides Positioning, Navigation and Timing (PNT) information services around the world. This study proposes that information redundant integration of PNT with other Global Navigation Satellite Systems (GNSS) will improve the capabilities of vessels to acquire navigation information during maritime navigation. It also has the potential to inform the advance of intelligent vessel navigation technology. Combining the infrastructure and information systems of the Donghai Navigation Safety Administration (DNSA) of China with the multiple GNSS information sources, this study confirms that the resultant Resilient Positioning, Navigation and Timing (RPNT) system improves the acquisition of PNT information and positioning accuracy for ocean-going vessels.

Key words：Precise Navigation; Multi-source Information; Resilient PNT; RTK

顶升平台碎石桩施工工艺在强浪条件下深水防波堤地基处理中的应用

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摘　要：依托某深水防波堤地基处理工程实例，通过对振冲碎石桩和开挖换填堤心石两种地基处理方式进行比选，针对振冲碎石桩施工窗口期有限以及开挖换填工程量大的施工难点，通过采用顶升平台进行海上振冲碎石桩施工，有效地保障了施工工效和施工精度，具有推广价值，值得类似工程借鉴参考。

关键词：强浪施工条件；深水防波堤；地基处理；顶升平台；碎石桩

Vibro-Flotation with Stone Column by Jack-Up Applied in Construction of Deep-Water Breakwater Foundation Improvement Under Strong Wave Condition

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Abstract：

Based on an actual project case of deep-water breakwater foundation improvement construction, this paper carries out a comprehensive comparation between vibro-flotation with stone column, and dredging with rock dumping. According to the difficulties as limited construction window of vibro-flotation with stone column, and large quantity of dredging with rock dumping, the jack-up is applied to guarantee the construction efficiency and accuracy, as a reference for similar projects.

keywords: Strong wave condition; deep-water breakwater; foundation improvement; jack-up; vibro-flotation with stone column.

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半掩护强浪条件作用下高桩码头设计与施工

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摘　要：依托某港区扩建项目，由于其新建码头在施工期处于强浪半掩护条件下，通过技术经济分析比选，确定了高桩梁板式的码头结构形式，并采用重力式沉箱作为后方陆域吹填的挡墙结构、利用桩间大棱体抛石形成护岸。通过对波浪场的数值模拟，对施工期沉箱的掩护效果及桩间抛石的消浪效果进行了验证。并在码头施工建设过程中，通过采用半潜驳预制沉箱、桩顶顶推平台沉桩以及桩顶装配式平台抛石，并利用BIM技术进行进度计划管理，保证了建设工期，为类似条件下的高桩码头设计与施工提供借鉴参考。

关键词：强浪；半掩护；高桩码头；波浪场数模；bim技术

Design and Construction of High Piled Wharf Under Semi-Shielded and Strong Wave Condition

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Abstract：

　　As an actual project case, considering the strong wave and semi-shielded construction condition, in accordance with the technical and economic analysis, the high piled wharf structure is applied with caissons as retaining structure and rock revetment. With a numerical simulation of the wave field, the protecting effect of caissons and wave eliminating effect of rock revetment are verified. During the construction phase, semi-submerged barge is applied for caisson prefabrication, pushing-jacking platform is applied for steel pipe driving, assembled platform is applied for rock revetment dumping, and bim technology is applied for schedule management to ensure the construction progress, as a reference for similar projects..

keywords: strong wave; semi-shielded; high piled wharf; numerical simulation of wave field; bim technology

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港口码头老化评价体系研究

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摘 要：随着投入使用时间的增长，港口码头老化表现得越来越显著，本文结合港口码头检测与评估相关数据，提出一种科学的、可操作性的港口码头老化评价体系，它对指导工程维修加固，维持港口设施技术状态良好，有重要意义。

关键词：港口码头；老化；评价体系

Research on Aging Evaluation System of Wharves

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Abstract：

With the increase of the service time, the aging performance of the wharves is becoming more and more significant. In this paper, a scientific and operable aging evaluation system for the wharves is proposed based on the relevant data of wharves detection and evaluation, which is of great significance for guiding the engineering maintenance and reinforcement and maintaining the good technical status of the port facilities.

keywords: wharves; aging; evaluation system

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东南亚海盗形势及防海盗措施研究

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摘　要：为了降低航经东南亚海域的船舶被海盗攻击的风险，利用国际海事局（International Maritime Bureau, IMB）发布的数据，对海盗问题现状、海盗攻击地域分布、船舶受袭情况、武器使用情况以及船员受威胁情况进行了详细的分析，总结了近年来东南亚海域海盗问题的总体形势。分析了海盗形成的原因，包括政治原因、经济原因和地理原因等。通过对海盗形势的分析，归纳总结该海域防海盗的措施。

关键词：东南亚海域；国际海事组织（IMB）；海盗攻击；防海盗措施

Research on Piracy Situation and Marine Anti-Piracy Measures in Southeast Asia

Zhang Feng , Dai Ran , Huang Fucheng , An Tiansheng , Cao Jie

（Dalian Maritime University）

Abstract：

In order to reduce the risk of vessels be attacked by pirates in Southeast Asia, the current situation of piracy, geographical areas of piracy, attack cases, weapons use and crew threats are analyzed in detail based on the data which released by IMB. Summarizing the situation of piracy in Southeast Asia in recent years. Analyzing the causes of piracy in different aspects, including political, economic and geographic reasons. Based on the analysis of the piracy situation, some anti-piracy measures are proposed.

keywords: Southeast Asia sea areas; International Maritime Bureau; pirate attack; marine anti-piracy measures

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偷渡行为对船舶航行的影响及处理

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摘　要：近年来，偷渡案件在各国各港口均有发生。随着各种防范措施的采取，虽然有减少的趋势，但仍存在很严重的偷渡现象。根据 P&I club 的各项公告显示，非洲等地的偷渡现象较为严重，世界各地亦均有发生。但大部分偷渡现象与远洋船员之间关系较为遥远，本文从贴近航海技术专业工作的角度出发，通过《1957 年国际偷渡公约》、《1965 年便利国际海上运输公约》这两部公约中定义规定的偷渡行为以及相关后续处置工作进行讨论，提出在当代航海条件下的偷渡对于航行的影响与几点对策。对于偷渡者可能对船舶航行各方面带来的影响及额外产生的问题进行全面的考虑分析，即能有效的减少偷渡行为的发生。而对于新形势下的防偷渡问题，应当做到海陆串联、船港联动，最大限度地利用资源，加强管理。

关键词：偷渡；船舶；航行安全

The Influences and Solution of Stowaways on Navigation

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Abstract：

　　In recent years, stowaways cases occurred in different countries and cities worldwide. Even though there was a decreasing trend with the assistance of various measures being taken, the stowaways act still exists. According to the data of P & I club, it demonstrates that the stowaways act occurs all over the world, especially in Africa where there is the most severe illegal phenomenon. However, the majority of the stowage act shown in P & I Club has little to do with seafarers in marine navigation, which becomes the initial aim of the paper. From the perspective of working reality of marine navigation technology, the author discussed the act of stowaways and the subsequent solutions based on two International Convention - International Convention Relating to Stowaways, 1957 and Convention on Facilitation of International Maritime Traffic, 1965 and pointed out the impact of stowaways on navigation as well as several effective solutions under the circumstance of current navigation situation. It is obvious that the stowaways could bring relevant influence on navigation and extra potential problems. So it is necessary to take all those factors into consideration which would be beneficial to reduce stowaways act. Therefore, in order to prevent this phenomenon, a series measures should be taken, for instance, combining the force of both sea and land, ship and port, making the fullest of resources and reinforcing relevant management.

keywords: stowaways; ship; navigation safety

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基于 DEMATEL-ANP 的水上大规模人命救助能力评价

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摘　要：水上大规模救助关系到乘客的生命和财产安全，是水上人命安全的重要防线。国际海事组织将大规模救助行动定义为需要对大量遇险人员做出快速反应的行动，这种情况下常规的搜救力量已经满足不了救助行动。文章基于 DEMATEL-ANP 方法提出了一种适用于水上大规模救助能力的评价方法，利用决策实验和评价实验室技术（Decision-making Trial And Evaluation Laboratory, DEMATEL）计算评价指标之间相互影响的强度，将 DEMATEL 与网络分析法(Analytic Hierarchy Process, ANP)方法相结合，利用 ANP 方法获得评价指标的权重，消除了 DEMATEL 方法将各评价指标权重视为相同的弊端。通过建立基于 DEMATEL-ANP 方法的水上大规模救助能力评价模型，从评价指标 ANP 权重排序、混合权重的评价指标关联度排序以及因果图等三个方面寻找影响大规模救助能力的关键因素，为提高水上大规模救助能力提供分析依据。

关键词：大规模救助；决策实验和评价实验室技术；网络分析法；混合权重

Research on Capacity Assessment of Mass Rescue with DEMATEL and ANP

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Abstract：

Maritime mass rescue is quite important to the safety of people's lives and property at sea. The IMO defines 'mass rescue operations (MROs)' as a 'mass rescue operation characterized by the need for immediate response to large numbers of persons in distress, such that the capabilities normally available to the search and rescue authorities are inadequate'. In this paper, a method was proposed for the capacity assessment model of mass rescue based on DEMATEL-ANP. The degrees of influences between the safety evaluation indexes were calculated by DEMATEL method. Considering the drawback that all the weights of evaluation indexes are treated as same value, ANP method was combined with DEMATEL and was used to calculate the weights of the safety evaluation indexes. A mass rescue capacity assessment model with DEMATEL and ANP was built in the paper. Based on the model it was proposed the key factors that affect mass rescue capacity from ANP weights ranking of assessment indexes, ranking of mixed weights of assessment indexes and cause and effect diagram, and it provides analysis basis for improving mass rescue capacity.

keywords: mass rescue; DEMATEL; ANP; mixed weight

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"桑吉"轮事故带给港口引航安全的启示

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摘　要：根据中国海事部门的事故调查报告，从"桑吉"轮和"长峰水晶"轮会遇态势发展出发，分析二者在各个不同会遇阶段的动态和驾驶台成员应对当时局面的处理方法。从报告中分析二者在驾驶台资源管理、瞭望、避让行动及船舶管理方面的不当之处，基于港口引航实际情况，提出引航在面对类似局面或情况时应对这些不足之处的对策和处理方法，以策港口引航安全。

关键词："桑吉"轮；调查报告；引航安全；驾驶台资源管理；瞭望；避让；配员适任

Enlightenment from the "SANCHI" Accident to the Navigation Safety of the Port for Pilotage

Li Feidi , Zhu Zhifeng

（宁波大港引航有限公司）

Abstract：

According to the accident investigation report of the Chinese MSA, starting from the development of the "SANCHI" and "CF CRYSTAL" , the dynamics of the two vessels at different encounters and the handling of the situation of the bridge members in response to the situation were analyzed. From the report, analyze the improper aspects of the bridge management, look-out, avoidance action and ship management. Based on the actual situation of port pilotage, this paper proposes countermeasures and treatments for piloting in the face of similar situations or situations. The method is to guide the harbor to pilot safety.

keywords: "SANCHI"; investigation report; pilot safety; bridge resource management; look out; collision avoidance; manning

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宁波舟山港化工品船舶多时段引航风险评估及控制

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摘　要： 本文较为全面的分析了宁波舟山港化工品船舶引航作业可能存在的风险因素，引入未确知测度法构建引航风险评价模型，揭示了化工品船舶进港引航操作风险的变化规律，对宁波舟山港其他船舶引航作业的风险规律研究有较大的借鉴作用。

关键词： 化工品船舶；引航操作；风险变化规律；未确知测度法

Multi-Period Pilotage Risk Assessment and Control of Chemical Vessels in Ningbo Zhou Shan Port

Wu Sheng , Zhu Zhifeng

（宁波大港引航有限公司）

Abstract：

　　This paper comprehensively analyzes the risk factors that may exist in the pilotage operation of chemical vessel in Ningbo Zhoushan Port and constructs pilotage risk evaluation modelby using unascertained measure method. It reveals the changing law of the risks of pilotage operation of chemical vessels in portand plays a great reference role in the study of risk law of other ships pilotage operation in Ningbo Zhoushan Port.

keywords: chemical vessel;pilotage operation;the law of risk change;unascertained measure method

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诠释学视野下的国际海事组织文本《人为因素统一术语》

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（集美大学）

摘　要：IMO《人为因素统一术语》已经发表多年。如果从诠释学的角度对该文本进行诠释，除了探讨文本的理解、解释和应用外，还可以有如下三个角度：首先是方法论诠释，它把理解和解释作为一种"方法"，着重于理解作者和文本的原意，这是严肃解读文本的必然要求；由于种种原因，要完整地理解文本的"原意"是非常困难的，因此，本体论诠释把理解和解释作为人类的一种"存在方式"，这使得文本的诠释呈现多元化，这要求人类相互之间要进行良好的沟通，同时要警惕由此可能带来的道德"虚无主义"而危害船舶安全；最后是基于信仰立场的诠释，它注重人生的信仰与信念，毕竟，信仰和信念对人类的行为产生重大影响，而 IMO 同样认为信仰是航运企业成功的安全文化建设的要素之一。

关键词：人为因素

On the IMO 《List of human element common terms》 Under the Vision of Hermeneutics

Chen Jinhui , Wang Yong

（jimei university）

Abstract：

　　《List of human element common terms》 has published for some years. If we made a interpretation of the text from the point of Hermeneutics, besides the discussing of the understanding and interpretation and application of the text, there are three points as below :the first is methodology hermeneutics ,it regard understanding and interpretation as a method, emphasizing the understanding of the original means of the text and the writer, this is a inevitable order for interpretation of the text seriously ;But for many reasons, it is very difficult to understand the original meanings of the text and the writer completely, so ontology hermeneutics regard understanding and interpretation as a way of being, and it present the pluralism in interpretations of the text, also demanding people to communicate well, and, we should take attention on that might course moral nihilistic to harm maritime safety；The last is biblical hermeneutics ,it　lay emphasis on;the faiths and believes of human being, after all ,the faiths and believes impact on the behaviour of human beings, and IMO regard that the beliefs is one of the success factors for the development of a safety culture.

keywords: human element

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基于号灯可见度的船舶夜航光环境物元分析评价

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（大连海事大学）

摘　要：为了探究夜航光环境对船舶号灯可见度的影响程度，保障船舶夜航的安全性。利用光学亮度对比度的原理，研究了船舶号灯的可见度，并引入色度学原理，将号灯和背景亮度的光色信息转换为等效亮度，代替其亮度。根据物标对比度等级，确定各类号灯评价等级的量值范围，构建船舶夜航光环境的物元综合评价模型，并以天津港南疆港区 4#码头的夜航光环境为例进行了实证研究，将《1972 年国际海上避碰规则》中号灯的技术数据代入可见度的计算。结果表明：该夜航光环境中除桅灯属于 V（影响可忽略）级外，左右舷灯、尾灯、拖带灯均属于 II（影响较大）级；综合来看，该光环境对夜航船舶号灯可见度的影响评价等级为 II（影响较大），并偏向 I（影响严重）。通过建立的评价模型，可研究船舶号灯在海上光污染水域的可识别性，为海上光污染的监测提供一定的理论依据。

关键词：船舶夜航；光环境；船舶号灯；可见度；物元分析

Evaluation of Ship Night Navigation Light Environment Based on Vessel Lights Visibility and Matter Element Analysis

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（Dalian Maritime University）

Abstract：

Abstract: In order to explore the influence of the night navigation light environment on the visibility of the ship light, the safety of the ship's night flight is guaranteed. Using the principle of optical brightness contrast, the visibility of the ship light is studied, and the principle of colorimetry is introduced to convert the light color information of the light and background brightness into equivalent brightness and replace its brightness. According to the contrast level of the object, the range of magnitudes of various light evaluation levels is determined, and the comprehensive evaluation model of the material in the night light environment of the ship is constructed, and the night light environment of the 4# terminal of Nangang Port Area of Tianjin Port is taken as an example. An empirical study was for case study, and the technical data of the medium-sized lamp of the International Regulations for Preventing Collision at Sea of 1972 was brought into the calculation of visibility. Through analysis, we draw the following results. The masthead light belongs to the V (impeded negligible) level, and sidelights, stern light and towing light all belong to II (larger impact) level. In all, the influence of the visibility of the lamp is evaluated as II (larger impact) and tending to I (significant impact). Through the established evaluation model, the visibility of the ship's light in light pollution area can be studied, which provides a theoretical basis for the monitoring of light pollution at sea.

keywords: ship night navigation; light environment; ship light; visibility; matter element analysis

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引航员人格特征现状分析研究

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摘　要： 人格是个体独有的稳定的心理特征的总和，与个人的行为方式紧密相关，在一定程度上决定了个人的行为方式与他人的差异。本文采用问卷调查和访谈相结合的研究方法，在大连、天津、青岛、威海、南通、常熟、上海、宁波、舟山、福州、广州、防城等港口中选取 326 名引航员作为调查对象，采用卡特尔 16 种人格因素问卷进行调查，得到有效问卷 302份。通过将引航员 16PF 各因素得分与全国成人男性常模进行单样本 t 检验，发现引航员在恃强性、兴奋性、有恒性、敢为性、敏感性、怀疑性、幻想性、世故性、实验性、独立性、自律性和紧张性 12 个因子上与普通男性存在差异显著，有统计学意义（p<0.05）。这些差异的具体表现为引航员在人格特质上具备独立积极、开朗健谈、团结合作、待人热情、自信敢为、责任心强、理智坚强、谨慎随和、精明老练、务实守规等特点。为了进一步深入了解引航员的人格特征，选取部分引航员进行访谈，综合 16PF 问卷的调查结论和访谈结果，综合考虑目前引航员队伍的现状和引航生产的需要，对引航员队伍的人员选拔和人格培养提出建议。

关键词： 引航员；人格特征；16PF；访谈

The Research of Personality of Pilots

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Abstract：

Personality is the sum of the individual＇s unique and stable psychological characteristics, and is closely related to the individual＇s behavior, and to a certain extent determines the difference between the individual＇s behavior and others. In this paper, it uses the method of questionnaire survey and interview, using the method of random sampling to arrive at the ports of Dalian, Tianjin, Qingdao, Weihai, Nantong, Changshu, Shanghai, Ningbo, Zhoushan, Fuzhou, Xiamen, Guangzhou and Fangcheng. A total of 346 safe recorders were selected as investigators, and the cartel＇s 16PF personality questionnaire was used to investigate. it is found that the pilot has the advantages of dominance, liveliness, rule-consciousness, social boldness, sensitivity, sensitivity, abstractedness, privateness, openness to change, perfection and tension(P <0.05). It represents that the excellent pilots in the personality traits with independent positive, cheerful talk, unity and cooperation, Self-confidence, strong sense of responsibility, easy-going, smart and sophisticated, pragmatic and other characteristics. Moreover, the pilot's professional characteristics have a higher degree for matching with their career, and also easier to get a higher sense of accomplishment at work. In order to further understand the personality characteristics of the pilot, the author selected the excellent pilot to interview, integrated 16PF questionnaire survey results and interviews.

Through the single-sample t test of the pilot's 16PF scores and the national adult male norm, considering the current situation of the pilot team and the need for pilot production, there are some suggestions for the pilot's personality training.

keywords: pilot;personality characteristics;16PF; interview

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船舶水上救生行为系统定性分析

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摘　要：船舶水上救生是指：适用于《海商法》的船舶，为最终达到某一个海区所有人命的安全，船上人员利用救生设备而进行的自救、互救以及接受外界救援的行动或者对其他海上遇难人员所实施的人命搜救的行动。这是一个以海上人命安全为目标的人类行为系统。因此，可以采用系统分析的方法对构成系统的各个要素，包括系统目标、救生设备、救生者、救生环境以及救生管理等的特殊性以及这些要素之间相互影响进行分析。首先是系统目标的选择原则以及影响救生目标确立的因素；其次是救生设备要素，它是系统的物质基础；再次是救生者要素，这是系统的主体要素，包括救生者的生理、救生知识与技能、道德、心理等因素；另外是船舶水上救生环境要素：包括船舶物质、人文与海难因素、自然环境因素、外界救援物质与人文因素；最后是船舶救生行为管理要素：包括船舶平时的救生演习、船舶发生重大险情时的救生行动、船舶接受外界救助的行动、船舶互救行动、船舶弃船行动、船员与旅客弃船后的求生行动、求生者接受救援的行动以及船舶水上人命搜救行动。船舶发生险情及从船舶弃船到海上求生的行动都可进行事件树（ETA)分析。因此，必须对该系统进行多学科、多层次的研究，才能进一步保障船舶水上人命安全。

关键词：水上救生

A Qualitative Analysis of the System of the of Marine Life-Saving Behavior on Water

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Abstract：

　　The concept of Marine Life-Saving on Water　is a action as below, the crew and passengers of a ship which is apply to the <Maritime Law>, using the life-Saving equipment of the ship , make self - aid and mutual aid ,and　accepting rescue by outside ,or rescuing other survivors at sea ,so as to reach the goal of life safety at sea final. This is a human behavior system which goal is for the survival and safety of human life at sea ,So,a system analytic method could be used to analysis of the features of every elements of the system and their relationships.The elements of the system includes goal ,life-saving equipment , life-savers, life-saving surroundings and life-saving management .The first is the　choosing principles of the system purpose and the factors that would effect the setting up of the life -saving goal;The second is life-saving equipment,it is the material foundation of the system;The third is the life-saver who is the main element of the system ,that includes of following factors :the physiology 、life-saving knowledge and skill 、moral and mentality;The forth is the element of surroundings which include these factors as below:shipping material and human culture、shipwreck、natural environment、life-aids of material

and human culture outside ;The last elements is the management of life-saving behavior which includes of   factors as below：The action of ordinary times.the life-saving action of a ship in a dangerous situation .the action of a ship to accept aid .the action of mutual aid between ships、the action of abandoning a ship.the survival after abandoning a ship.the action for the survivors to accept aids and the search and rescue action of a ship to aid the survivors on water.Both of the life-saving action of a ship in a dangerous situation and the action from abandoning a ship to survival could be analysis with the method of ETA. a conclusion could be get that for The purpose of enhance the   marine safety of life on water ,a systematic research with interdisciplinary and multilevel on the behavior of   marine safety of life on water is very important.

keywords: life-saving on water

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梅山码头全潮时引航靠泊风险评估与应用

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摘 要：为全面梳理和管控梅山码头集装箱船舶引航作业的风险，对影响船舶引航作业的主要因素进行了分析，在此基础上进一步综合分析了船舶引航作业在各时段的危险源。为此，根据失效模式与影响分析、作业条件危险性分析方法，提出了梅山码头集装箱船舶全潮时靠泊的风险分析、LEC 计算和应对风险的措施，通过熔断机制的引入，既能从源头上把控引航作业风险，又能依据数据计算对每一项危险源的风险细节进行掌握并提出改正措施。

关键词：全潮时；危险性分析法；熔断机制；风险控制

Risk Control Method and Practice of All Tide Time Pilotage Operation in Meishan Port

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Abstract：

In order to comprehensively comb and control the risk of the navigation operation of the container ships in Meishan port area, the main factors affecting the ship"s manoeuvring are analyzed. On this basis, the dangerous sources of the ship"s pilotage operation in each period are further analyzed. To this end, the risk analysis, fuzzy calculation and measures for risk response of container ships in Meishan port area are put forward according to the method of failure mode and LEC method. It can not only make the risk control of the pilotage operation from the source, but also calculate the risk of each risk source on the basis of the number of data.

keywords: all time; LEC method; fusing mechanism; multi periodrisk control

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走锚船稳定漂移速度计算模型及实例计算

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摘　要：本文考虑风、流、及锚链力的共同作用下，锚泊船的受力情况，在锚泊船稳定向下风漂移后，根据力矩平衡原理，理论推导出走锚船稳定向下风漂移时的速度模型，再通过实例计算进行计算验证，初步证实了模型的准确性。

关键词：锚泊风险评估；走锚；稳定漂移；速度模型；实例计算

Calculation Model and Case Calculation of Stable Drift Speed of Dragging Anchor Ship

Li Yan , Huang Teng

（Dalian Maritime University）

Abstract：

In this paper, considering the combined action of wind, flow and anchor chain forces, the force of the anchoring ship, after the anchor ship is stable to the downward wind drift, according to the principle of torque balance, theoretically derive the speed model of the stable downwind drift of the anchor ship. The calculation is verified by the example calculation, and the accuracy of the model is preliminarily confirmed.

keywords:anchorage risk assessment;anchor dragging;stable drift;velocity model;instance calculation

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Modelling of Regional Vessel Near Collision Risk Assessment with Convolutional Neural Network

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Nanjing University of Science and Technology   Enjoyor Co., Ltd.   Nanjing University of Science and Technology   Nanjing University of Science and Technolog）

Abstract：

With the rapid development of maritime transportation, a reliable and reasonable judgment of vessels for near miss collision risk is greatly beneficial to the ship safety and operation. Traditional collision models may have a serious deviation from the reasonable situations, rather than always giving reliable judgments. If the ships always need experts＇knowledge, although the reliability of judgment is enhanced, it will greatly increase the experts＇workload, which is also unrealistic. In this paper, a deep learning method based on convolutional neural network (CNN) has been proposed and applied in detecting the near miss collision risk for regional vessels. This model can reconstruct the error of the output and minimizes the error, and then improves the accuracy of the network through a large number of inputs and frequent iterative training. It is noted that the error is the difference between the CNN model outputs and the reliable data labels. Thus, according to the mathematical model we set up and experts＇knowledge, a large scale of reliable data labels for CNN are obtained. In addition to the input maps, the basic sailing factors data that is a vector fed into the multiple fully connected layers of the CNN. Due to this adding data, the model accuracy is improved by 5.58％. The Baltic Sea is taken as the case study, and the Automatic Identification System (AIS) equipped in the vessels provide traffic data of the ocean areas for this research.

Key words：marine traffic situation; near miss collision risk; Automatic Identification System; convolutional neural network; the Baltic Sea

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破冰船护航行为多船跟驰模型

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（南京理工大学）

摘　要：在冬季的冰区，普通船只航行困难。在这种环境下，破冰船对于维持航海的正常工作很有必要。但是随着船只数量和破冰船护航行动的增加，船航行的安全也越来越受到重视。本文针对破冰船的护航行动，提出了冬季条件下的多船跟随模型。本研究将安全速度和安全距离考虑在模型之中，并且结合冰对船的阻力进行研究。通过分析和验证，均表明该模型能为船舶稳定和安全航行提供准确的理论参考。

关键词：水运安全；多船跟随模型；安全速度；护航操作

Multi-Ship Following Model for Icebreaker Escort Operation Behavior

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（Nanjing University of Science and Technology）

Abstract：

　　In winter, ships sail difficulty in ice-covered water. In the area, the icebreaker is necessary to maintain safe navigation. However, with the increase of vessels and icebreakers, the risk is being increasing. In this paper, a multi-ship following model is proposed for escort operation. This study constructs the following model by considering both safe speed and safe distance. Moreover, the ice resistance of ship is taken into consideration in the model. Through the analysis and verification, the model can provide accurate theoretical reference for ship stability analysis and safe navigation.

keywords: maritime safety; multi-ship following model; safe speed; escort operation

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基于 CREAM 的海事应急处置人因可靠性研究

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摘　要：为了提高对人因可靠性定量预测的准确性，基于认知可靠性与失误分析方法（CREAM），建立海事应急处置人因可靠性分析模型。针对应急处置情景环境的综合特征，引入层次分析法定量计算影响指数，即 CPCs 权重值，实现对人因可靠性的准确预测，对人误根原因的有效探究，降低人因失误率。结合实例对某海事应急处置任务中人因可靠性进行分析，结果表明任务过程中人因失效概率值为 1.985×10-2，对应的控制模式为"战术型"，验证了改进方法合理易行，值得推广。

关键词：人因可靠性；认知可靠性与失误分析方法；层次分析

Study on Human Factor Reliability of Maritime Emergency Treatment Based on CREAM

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Abstract：

In order to improve the accuracy of quantitative prediction for human factor reliability, a human factor reliability analysis model was established based on cognitive reliability and error analysis method (CREAM). In view of the comprehensive characteristics of the emergency situation environment, the analytic hierarchy process was introduced to calculate the influence index, namely the weight of CPCs, for characterization, so as to achieve a more accurate and objective prediction of the reliability of human factors. In addition, the root cause of human errors was verified to reduce the error rate of human factors. For example, the reliability of human factors in a maritime emergency disposal task is analyzed, and the results show that the probability of human factors failure in this accident is 1.985E-2, and the corresponding control mode is tactical. It is proved that the improved method is reasonable, easy and worth popularizing..

keywords: human reliability; CREAM; hierarchical analysis

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Ship Collision Risk Factors Analysis Combined with Bayesian Space-Time Model

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Abstract：Using Bayesian model to analyze maritime traffic risk is a common and effective method. However, most of the Bayesian methods have been used for analyzing marine traffic accidents are conventional Bayesian network models which hardly clarify the temporal and spatial inter-correlation characteristics of vessels collision accidents. From this perspective, a Bayesian space-time model is proposed to analyze the historic maritime collision data and identify key factors caused accidents along with the space and time correspond. Besides, series sensitivity analyses are conducted to make sure numerical results accurate and reliable. The research results show that the space-time interaction has a significant impact on the occurrence of maritime collision accidents. It is worth pointing that ship age, flag, PSC inspection times and ship type are the remarkable factors resulting in ship collision. Furthermore, the relative risk probability value and collision rate of the ship is compared and find that the collision risk probability value is not necessarily at a high level in areas with high collision rate and vice versa. These above research results can provide strong support for the decision-making of maritime management bureau.

Key words：traffic risk analysis; bayesian space-time model; sensitivity analysis; risk factor; relative risk

三峡-葛洲坝两坝间水上交通事故分析

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摘　要：在对长江三峡和葛洲坝两座水利枢纽之间的通航环境、交通流密度等分析的基础上，结合两坝间航道的特点，分别从事故类型、发生航道、发生月份等方面统计分析了 2003-2016 年的事故数据，并计算了事故风险值，以期为通航环境的优化、船舶航行风险管理等提供决策基础。

关键词：三峡-葛洲坝；事故险情；事故风险值

Maritime Accident Between Three Gorge and Gezhou Dam

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Abstract：

Navigational conditions and traffic flow in the waterway between the Three Gorges and Gezhou Dam are studied. Then statistical analysis of historical accident data from 2003 to 2016 is performed considering navigational area, location and time interval. Meanwhile, accident risk index is determined to provide guidance for enhancing maritime safety.

keywords: three Gorges-Gezhou Dam；maritime accident；accident risk index

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含有隐藏变量的贝叶斯网络海上安全研究——基于 PSC 检查结果对船舶事故及后果的影响

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摘　要：为了更有效地防止船舶事故，本文构建贝叶斯网络（BN）模型来研究各种因素对船舶事故及其后果的影响。同时，引入隐藏变量——安全水平，用来汇聚复杂的港口国监控(PSC)检查结果，提高模型的可靠性。通过模型分析，不仅可以锁定影响船舶事故的关键因素，还可分析各类事故的后果。本文使用的数据是来自劳埃德船级社（LR），国际海事组织（IMO）和东京备忘录（MoU）三个数据库的组合数据。通过 Greedy thick thinning（GTT）算法学习该模型结构，同时利用 K-折交叉验证、对数似然函数（LL）对模型进行评估。为了确保模型的有效性，本文还采用整体性分析验证模型的有效性。结果表明，船型和安全水平对船舶事故的影响最为显着。另外，结果还验证了 PSC 检查对事故预防的有效性。

关键词：船舶事故；贝叶斯网络；隐藏变量；安全水平；港口国监控检查；事故后果

Maritime Safety Analysis Using Bayesian Network with a Hidden Variable——The Impact of PSC Inspection Results on Ship Accidents and Consequences

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Abstract：

This study attempts to establish a Bayesian network model to study the effects of various factors on ship accidents and accident consequences in order to prevent ship accidents more effectively. A hidden variable is introduced to represent the ship's safety level based on the PSC inspection results to improve the reliability of the model. The proposed model can not only help identify the key factors affecting ship accidents, it helps analyze the consequences of various types of accidents as well. The data used in this study is obtained from three databases, Lloyd's Register of Shipping (LR), International Maritime Organization (IMO) and Tokyo Memorandum (MoU). The model is learned using the Greedy thick thinning algorithm (GTT). It is then employed the K - fold cross-validation, logarithmic likelihood function (LL), and sensitivity analysis to verify the validity of the model. The results of the model show that ship types and the safety level index have the most significant impact on ship accidents. More importantly, the results also validate the effectiveness of PSC inspections on accident prevention.

keywords: ship accident, bayesian network, hidden variable, safety level, port state control inspections,accident consequences

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Analysis of Port Risk: A Case Study in Ukraine

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Abstract： This study reached two goals. The first goal was to develop a reasonable method for quantitative port risk assessment and gain numerical results for total port risk. The second goal was to apply developed method in a case of risk assessment for four major Ukrainian ports: Yuzhny, Odessa, Chernomorsk, and Nikolaev.AHP method was taken as a base for port risk assessment in this study. Concept of median was used to normalize all collected expert judgments into one judgment value.This research gives a good opportunity for Chinese "One Belt, One Road" project's authorities to understand situation in Ukrainian port industry and to develop their own risk management strategy for activities in Ukrainian ports. In addition, results and the analysis provide port authorities a distinct picture of the most risky areas of a port's activities.

Key words： port risk assessment; AHP; Ukrainian ports; data normalization; expert judgments

以"泽宏"轮搁浅事件为例浅析船舶搁浅的原因及预防措施

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摘　要：船舶搁浅事故时有发生，如何能更好的预防船舶搁浅成为航运界讨论的热点。最近"泽宏"轮搁浅事件，一定程度上引发人们对搁浅事故的关注。本文通过查阅相关资料，对"泽宏"轮搁浅事件过程做了简要的概述，分析了搁浅事故的船舶状况、事发水域环境、损失状况、船员情况等。对致使其搁浅的原因进行了详细的论述，包括船员操纵、情景意识、海图更新、港调与船舶的沟通协调等，并从船员、船公司以及海事监管部门，这三个方面提出船舶搁浅预防措施的建议。希望引起有关部门的重视，降低船舶搁浅事故的发生率,保障船员和船舶的安全。

关键词："泽宏"轮；搁浅；原因分析；预防措施

Taking the "Zehong" Wheel Stranding Incident as an Example to Analyze the Causes and Preventive Measures of Ship Stranding

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Abstract：

　　Ship grounding accidents occur sometimes, so how to prevent the ship grounding much effective which has been the hottest spot discussed by the shipping industry. Recently, the grounding accident of MV 'Ze Hong' that led people to concern about the accident in some extent. This paper makes a brief overview of the grounding process of MV 'Ze Hong' through the relevant information, analyzes the ship condition, the environment of the incident, the loss situation of the accident, the situation of the crews etc. The reasons for the grounding were discussed in detail, including crew manipulation, situational awareness, chart updating, the coordination between port and vessels. And put forward several requirements to crew members, shipping companies, and the shipping departments which will provide effective and valuable measures in order to protect vessels from grounding at sea. Hope to attract the attention of relevant departments, reduce the rate of ship grounding accidents, and protect the safety of seafarers and vessels.

keywords:MV 'Ze Hong'; grounding; reason analysis; preventive measures.

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A Comparison of Practices of Green Port Policy in China and South East Asia Under Belt and Road Initiative

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Abstract： The ever-increasing environmental concern in maritime transport motivates port sector to pay more attention to environmental impacts of shipping activities and port operations. As such, the concept of "Green Port" has been proposed and implemented around the world. The importance of green port policy measures may be differentiated for those countries who tend to achieve the overall performance of green port policy with a focus on reduction in carbon emissions. This research presents a comparative analysis of practices and effects of green port policy in China, Malaysia, Singapore, Thailand, and Vietnam. First, a comprehensive review of green port policies implemented in five Asian Ports in these countries is given with a set of highlights of the future challenges for other ports in this region. This review offers some policy recommendations, which may be relevant to other developing ports. Second, among these, it was identified that China, Malaysia, Singapore, and Thailand have adopted the green port policy effectively. Besides, both China and Singapore currently implement a more varied set of criteria targeting at green ports as compared to the aforementioned other three countries. Moreover, China and Singapore support development and implementation of automatic terminals, as part of practice of their Green Port policy.

Key words： green port; port policy; Eco-Port; marine transport management; belt and road initiative

Dynamic Recovery Actions in Multi-Objective Liner Shipping Service with Buffer Times

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Abstract：This paper explores the dynamic recovery polices for liner shipping service with the consideration of buffer time allocation and uncertainties. A novel mathematical formulation is introduced to solve the robust vessel scheduling problem with short and long term decisions. In the proposed mathematical formulation, several decision variables are optimized, including buffer time allocation, speed strategy, skipping one port of call, accelerating handling rate, subjected to regular uncertainty and disruption event. Various uncertainties may cause vessel delays and the increase of carbon emissions. The trade-off analyses are conducted between economic, environmental and social benefits. Two heuristics are proposed to solve the model. Experiments on the container service routing show the validity of the model.

Key words：liner shipping; emissions; uncertainty; robust scheduling; dynamic recovery actions

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Modeling the Integrated Quay Crane and Shuttle Vehicle Scheduling Problem with Apron's Buffer Constraint

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Abstract：The integrated quay crane and shuttle vehicle scheduling problem is one of the most important problems for the operations at container terminal. The integrated problem aims to decide multiple QCs' schedule for unloading containers and multiple SVs' schedule for transporting containers so as to minimize makespan of all jobs. This problem is subject to the practical constraints of nonzero crane repositioning time, precedence relationships between container jobs, quay crane interference, safety margin, blocking, and the buffer capacity constraint. A mixed-integer programming formulation is proposed to solve the problem and has been verified through multiple test runs with different cases. Results indicate that the problem is solved efficiently, especially for small problem sizes.

Key words：container terminal; quay crane scheduling problem; scheduling optimization; the integrated scheduling problem; mixed-integer programming

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基于层次分析-模糊综合评价海事应急救援技术等级评价

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摘　要：水上应急救援一直是海事机构高度关注的问题，水上应急救援能力在不同地域的发展参差不齐，因此根据实际中具体问题，如何合理评价各海事机构的水上应急救援能力成为关注的重点。层次分析法（AHP）通过合理的运用专家经验和数据分析来解决此类问题。根据问题属性类别差异建立层次结构模型，通过将复杂问题逐一分解，得到问题的本质因素并分析其所占比重，结合模糊综合评价理论（FCE）构造隶属度函数与评价集合，得到符合实际的综合评价结果。以层次分析法和模糊综合评价理论为核心的 AHP-FCE 数学模型，具有较强的实用性、逻辑性和系统性。将影响应急救援能力的各个因素考虑在内，结合定性与定量的分析方法得到最终评价结果，以尽量避免个人主观臆断带来的弊端，使计算结果具有更强的稳定性和客观性，以得到最切合实际的评价分析结果。AHP-FCE 方法不仅简便和适用，其适应性强，更可应用到多个领域，为解决不同领域的类似问题提供了一个新思路，实验结果表明，使用此方法得到的分析结果与专家的认可度一致。

关键词：水上应急救援；层次分析法；模糊综合评价

Research on the Grade Evaluation of Maritime Emergency Rescue Based on AHP-FCE

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Abstract：

　　Maritime emergency rescue has always been the focus of maritime organizations. As for the uneven of the development of water emergency rescue capabilities in many regions , it has become the top point that how to precisely evaluate the water emergency rescue capabilities of various maritime organizations. Analytic Hierarchy Process (AHP) collect expert experience and through data analysis to solve such task. The model of the hierarchical structure is established on the base of target attribution and decomposed the target to many factors. The membership function and the evaluation set are constructed through Combining AHP with the Fuzzy Comprehensive Evaluation (FCE) to acquire the actual integration. Using the AHP and FCE theory as the core, the AHP-FCE mathematical model has strong practicability, logical and systemic attribution. This model takes the various factors affecting the ability of emergency rescue into account, and combined with qualitative and quantitative analysis methods to acquire the final evaluation results, so that the disadvantages could be avoided caused by personal subjective judgment. The results acquired through this method have stronger stability and objectivity, and are consistent with realistic situation. The AHP-FCE method is simple and applicable, and it has already been adapted to many fields. It also provides a new idea for solving similar problems in other fields. The experimental

results show that the analysis results acquired utilized this method are consistent with analytic results of experts.

keywords: Maritime emergency rescue; AHP; FCE

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对我国自由贸易试验区国际船舶登记相关问题的探讨

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摘　要：自 2017 年 2 月 10 日开始，我国在严格船舶登记制度的基础上取得突破创新，正式开始施行自由贸易试验区国际船舶登记制度，国际船舶登记实施两年多以来，对于表明中国政府在船舶登记方面的开放、鼓励的态度起到了积极作用，但与此同时，国际船舶登记在施行过程中遇到的困难和问题也逐步浮现。本文在解析了我国国际船舶登记政策特点和分析了国外国际船舶登记制度要求的基础上，重点给出了我国国际船舶登记现状的原因及海事监管存在的需解决问题，提出了国际船舶登记更好发展的相关建议。

关键词：自由贸易试验区；国际船舶登记；海事监管；发展建议

The Discussion on Issues Related to International Ship Registration in Chinese Free Trade Zone

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Abstract：

Since February 10, 2017, China has made breakthroughs and innovations on the basis of strict ship registration system, and officially began to implement the international ship registration system in the free trade test zone. Since the implementation of the international ship registration for more than two years, it has indicated that the Chinese government is registering in the ship. The open and encouraging attitudes of the parties have played a positive role, but at the same time, the difficulties and problems encountered in the implementation of international ship registration have gradually emerged. Based on the analysis of the characteristics of China's international ship registration policy and the analysis of the requirements of foreign international ship registration system, this paper gives the reasons for the current status of China's international ship registration and the problems that need to be solved in maritime supervision, and proposes international ship registration. Relevant recommendations for future development..

keywords: free trade zone; international ship registration; maritime supervision; development proposals

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港区低碳发展措施的探讨与研究

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摘　要：本文针对港口低碳发展的措施进行了探讨与研究，主要分析了更绿色的运输方式（例如海铁联运、驳船运输等）和设施改造（例如，龙门吊"油改电"、龙门吊混合动力、液化天然气（LNG）拖车及节能照明等）。基于国内外诸多先进港口建设绿色低碳港口的经验，提出了港口低碳模式的发展的四点注意事项，为国内港口的低碳发展提供参考。

关键词：港口；低碳；措施

Research on Measures for Low-Carbon Development at a Port

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Abstract：

In this paper, measures for low carbon development at a port are discussed and explored. There are mainly two types of measures, including greener transportation mode (such as sea-rail combined transportation and barge transport), and reconstruction of facilities (for instance, "oil to electricity" of gantry crane, hybrid electrical gantry crane, LNG trailer, and energy-efficient lighting). Based on the advanced domestic and overseas experience for low-carbon ports, four suggestions are given. The paper is useful for related ports and scholars with the objectives of low-carbon development for ports..

keywords: port; low-carbon development; measures

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Measuring Risk in Dry Bulk Shipping Market : A Value-at-Risk Approach

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Abstract：This paper tends to propose a simple but valid value-at-risk (VaR) approach to measuring the risk in dry bulk shipping market by means of Baltic Dry Index (BDI). A rich dataset of BDI allows us to carry out a non-parametric historical simulation experiment on the cyclical and violate shipping industry. The bellwether phenomenon of dry bulk shipping market is explored and discussed, both qualitatively and quantitatively. The experiment indicates that the dry bulk shipping market and BDI are easily influenced by seasonal variations. Furthermore, the analysis points out that dry bulk shipping market is expected to be a buoyant market at a 99% confidence level. To some extent, this result can help to improve the prediction of risk in dry bulk shipping market. Besides, this paper has identified a number of desirable strategies to help shipping companies of different sizes hedge market risks.

Key words：non-parametric model; risk management; dry bulk shipping market

Positioning Handshake Bay in a Container Stacking Block Under Energy Optimization

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Abstract：Sustainable development is concerned in automated container terminal where automation technology and equipment are used to achieve the goal of energy saving and operation efficiency. Twin automatic stacking cranes (ASCs) are such a solution to handle container storage and retrieval in stacking block with a handshake bay for crane coordination. In this paper, a mixed integer linear program is formulated to schedule the twin ASCs meanwhile position a handshake bay to reduce crane idle time and avoid crane interference. Multiple objectives are established to minimize the makespan and, simultaneously the potential energy consumption, which is calculated by considering the crane moving and hoisting operations with and without a container. Experimental results indicate that the energy consumption can be reduced by at most 16% while remaining the makespan by adjusting the handshake bay. A Pareto analysis demonstrates that the impact of handshake bay on the energy consumption is more notable than on the makespan, 12% of energy-saving is observed in the examined instances.

Key words：yard crane scheduling;energy consumption;automated container terminal; energy consumption; automated container terminal; handshake bay; logistics management

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Hinterland Competition Between Maritime Ports via Positioning Dry Ports

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Abstract：With the "One the Belt and One the Road" strategy, the construction of dry ports is conducive to the expansion of the hinterland of the port, and it is of great practical significance to promote regional economic growth and achieve "win-win" between the port and the hinterland. This paper establishes a model to analyze the equilibrium decision-making of the location of dry ports in Shanghai and Ningbo Ports under competitive conditions. We apply the integer programming model to reduce the range of candidate nodes which makes it possible to use enumeration algorithm to seek out equilibrium solution.

Key words：dry port; location selection; the integer programming model; economies of scale

A Review of Promotion of Shore Power as an Option of Reduction in Shipping Emissions

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Abstract：It has been almost 20 years since Sweden installed the first commercial shore power in 2000. Although there are many ports and ships installed shore power (also known as cold ironing) nowadays, only a few of ships plug in cold ironing when they berth at the port because of various issues. The previous papers mainly focus on the safety, evaluation and cost benefits of installing shore power. This paper presents a detailed review of the existing literature on shower power use/promotion, including general statistics, factors, methodology and results of sub-fields. One key finding is that the emission evaluation, cost and cost-benefits with a top-down approach are the first three most-discussed themes in the transportation research. Besides, the characteristics, feasibility and how to improve the technology of show power have been paid a great attention in the electronic engineering literature. Emerging directions in this field include making a questionnaire survey to know the willing and attitude of all stakeholders, the influences of different emission factors to the benefits of cold ironing and balancing the cost-benefit of cold ironing among all the stakeholders properly or making a method to decide who may be the best or most suitable shareholder to finance the costly system..

Key words：shore power;technology; emission reduction; ports and shipping; development

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Duopoly Facility Location Equilibrium in the Context of Cross-Border E-commerce

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Abstract：This paper studies the equilibrium problem of duopoly facilities in the context of cross-border logistics. The two suppliers select the location of their respective distribution centers in a specific area and determine the price of the products by the delivery cost to maximize their respective profits. Assuming that the product is completely inelastic and the marginal procurement cost is unchanged, the supplier determines the equilibrium price after the price competition, then the position-price game can be transformed into a location game, and the global cost minimization is the location equilibrium solution. For this kind of multi-supplier and multi-demand point Weber location problem with no capacity constraints, we propose a traversal-based algorithm that obtains the optimal solution by traversing all customer service sequences. After testing on different scale instances, we found that the proposed algorithm performed well on small and medium-sized instances.

Key words：cross-border logistics; facility location equilibrium; oligopoly competition; two-stage game

Clustering Analysis of Port Throughput Based on Dynamic Time Warping

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Abstract：In order to study and analyze the characteristics of different ports to realize the research on the relationship between ports, this paper uses port throughput as the research object, and proposes the use of dynamic time warping (DTW) as a measure of similarity and adopts K-Means clustering algorithm for cluster analysis of ports. Through the cluster analysis of the port, the clustering algorithm is clustered into the same type of port characteristics and the connection between ports.

Key words：cluster analysis; similarity measure; DTW algorithm; K-means clustering algorithm; port throughput

Dynamic Time Warping in Shipping

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Abstract：Due to the law of development of things, data mining on time series data is becoming an important part of big data decision-making. As a basic operation of time series data mining, time series data similar connections can find all similar time series data pairs under a given similarity measure. Research shows that Dynamic Time Warping (DTW) is the best measure of similarity in time series data in more and more scientific and social applications such as text mining and trend prediction.

Time series data is generated in various application fields in daily life, such as network security monitoring data, daily fluctuation data of the stock market, experimental observation data in medicine and biology, industrial monitoring sensor data, and the like. Therefore, most of the existing research is in these fields. In fact, the port and aviation field also has a lot of time series data, such as the throughput of the container, the trajectory of the ship and so on. Analysis of these data can be very helpful in predicting and finding the optimal path.

This paper focuses on the model and algorithm of dynamic time warping, and proposes a new model based on mathematical model to find the shortest path of dynamic time warping.

Key words： time series; similarity measure; port shipping

Modelling of Port Green Emission Reduction and Price Decision Under Various Market Competition Environments

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Abstract：With the implementation of low-carbon, energy-saving and emission reduction, the construction and development of green ports are increasingly important. In this paper, the green emission reduction and price competition between two adjacent ports (one green port and one ordinary port) in the market is considered around the regional port environment. With Stackelberg and Nash game theory, the decision-making models included green port as the market leader mode (GL mode), ordinary port as the market leader mode (OL mode) and no market leader mode (NL mode) are respectively established, and the influence of various market competition environments on green emission reduction and price decision are investigated. The results indicate that the service price of green port is positively correlated with the emission reduction rate, while the service price of ordinary port is negatively correlated with it. Various market competition environments will affect the green emission reduction rate in ports, the green emission reduction rate under the GL mode is the best, followed by the NL mode, and the OL mode is the lowest. The green emission reduction rate is negatively correlated with the difficulty coefficient of green technology innovation, and positively correlated with the unit green subsidy of government. The governmental green subsidy for green port has effectively share the investment and risk in the early stage of green emission reduction. With the green service preference degree of ships is higher enough, the emission reduction rate will be consistent no matter in which mode. The government also needs to advocate green behaviors when subsidizing green ports, so as to enable more market player to participate in green consumption.

Key words： green emission reduction; price decision; port competition; market environments; game theory

Routing AGVs in a Temporal-Spatial Network at Automated Container Terminal

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Abstract：This paper focuses on the routing and scheduling of AGVs in automated container terminal. A new shortest-path optimization algorithm based on temporal-spatial network is proposed, which considers the impact of AGV on other lanes. In our experiment, we generate temporal-spatial networks to search the shortest paths of AGVs. The results showed that this algorithm can schedule shortest paths without collision in many tasks efficiently. This scheduling of AGV is reasonable, which improves operation efficiency of the terminal.

Key words：automated container terminal; temporal-spatial network; shortest path; automated guided vehicle.

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Locating Competitive Dry Ports for a Maritime Port Using Game-Theoretical Model

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Abstract：With the competition of port scale extending to the hinterland competition and the continuous development of inland transportation, container inter-modal transportation and the development of dry port are getting more and more attention. This paper develops a game-theoretical model to determine the dry port locations. The players of the game are two dry port operators. In the competitive environment, each dry port operator determines the optimal strategy for dry port location given the strategy of the competitive dry port. An equilibrium solution can be obtained by solving the model to determine the dry port locations.

Key words：dry port; facility location problem; game theory; maritime studies; location game

Long-Range Dependence and Multifractality of Ship Flow Sequences in Container Ports a Comparison of Shanghai, Singapore and Rotterdam

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Abstract： In this paper we present evidence of long-range dependence in container ship flow sequences by using the Multifractal Detrended Fluctuation Analysis (MF-DFA). We study a data set from January 1, 2013 to December 31, 2017, for three representative container ports in the world (i.e. Shanghai, Singapore and Rotterdam). Empirical results suggest that ship flow sequences are not normal distribution, and the sequences with different time scales exhibit varying degrees of long-range dependence. Furthermore, ship flow sequences have a multifractal nature and the larger the time scale of ship flow time series, the stronger the multifractal characteristics are. The monthly ship flow sequence of Singapore port has the highest degree of multifractality. What's more, the multifractality presented in the ship flow sequences of container ports are due to the correlation properties as well as to the probability density function of the ship flow sequences. These findings suggest that modelling and predicting of maritime ship flow series should take these features into account..

Key words： container ship flow sequences;volatility;generalized hurst exponents; long-range dependence; multifractality

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Joint Optimization of QC, ALV and ASC Constrained by Yard Block Buffer Capacity at Automated Container Terminals

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Abstract：Joint optimization of multi-level task has always been an important issue in the system of automated container terminal. This paper has studied the problem of joint optimization of quay cranes (QC), automated lifting vehicles (ALV) and yard cranes (YC) through modelling, as well as considered the constraint the block buffers imposes on container operations. To minimize the make span of container operations, a mathematical program that can be solved by existing mixed integer linear program solver is formulated. At the same time, multiple sets of experimental data are set up and solved by MILP to verify the feasibility of the model. Explain that QC, ALV and ASC can be jointly optimized under the constraints of the buffer.

Key words：automated container terminals; buffer; optimization; equipment

Joint Scheduling of QC, ALV, YC and Yard Block Buffers in ACT

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Abstract：The automated container terminal (ACT) is a whole, with interaction and constraints between multiple handling equipment operations. In order to solve complex joint scheduling (j-scheduling) problem which to improve the efficiency of ACT, an objective is set to minimize completion time of unloading tasks, and a mixed integer linear programming model is created for j-scheduling of quay cranes, automated lifting vehicles, yard cranes and block buffers in ACT. The model takes into account the allocation of buffer devices in j-scheduling process, which can effectively avoid conflicts and congestion when multiple vehicles select to enter the same buffer device according to the shortest distance principle at the same time. Gurobi solver is used to solve the model. Through numerical analysis, the correctness and validity of the model can be proved, which means the model can provide decision support for equipment scheduling of ACT.

Key words：automated container terminal; quay cranes; automated lifting vehicles; yard cranes; block buffers; joint scheduling

Quay Crane Scheduling Considering Double-Cycling Strategy

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Abstract：This paper aims to propose an effective method for quay crane scheduling to reduce the risk of vessel departure delay. A mixed integer programming model, which covers a wide range of operational and structural constraints, is formulated to solve the quay crane scheduling problem with a novel objective. A case study is presented and a number of numerical experiments are conducted to validate the effectiveness of the proposed model. Meanwhile, some management insights are proposed. The results demonstrate that the proposed method can efficiently solve quay crane scheduling problem in container terminal, and an interesting phenomenon is found that reducing the stacking layers can improve the operational efficiency of quay crane.

Key words：Container terminal; mixed integer programming; double-cycling strategy; hatch covers

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Sustainable Maritime Inventory Routing Problem: Features, Models and Algorithms

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Abstract：There are many studies about sustainable vehicle routing problems (VRPs) and inventory routing problems (IRPs), while there are few studies about sustainable maritime inventory routing problems (MRIPs), which are a special class of IRPs that occur in maritime transportation environment in fact. In this paper, several articles about MIRPs, sustainable VRPs and IRPs are reviewed. After summarizing, the paper also speculates how carbon emission limits, as additional model features, are reflected in the core model of MRIPs. To verify the feasibility of the idea, this paper also uses a data set to calculate vessel schedules with and without carbon emission limits. Experimental results show that, when carbon emission is limited, the frequency by which vessels move between the demand port and the supply ports will be significantly reduced, and more bulk cargo will be shipped to multiple demand ports, instead of meeting the demand of only one port. In this case, even though vessels' overall profits have fallen, their cruising speeds are slowed so much that the carbon emission is reduced by 74%. It can be seen that the sustainable constraints in VRPs and IRPs are equally valid in MIRPs.

Key words：sustainability;maritime inventory routing problem; mixed-integer linear program; port and shipping; logistics management

Greening the Mongolia Export-Oriented Mineral Flows Based on Hub-and-Spoke Network

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Abstract：The mineral industry is one of the important pillar industries of Mongolia's economic development. The mining industry accounts for 89% of Mongolia's exports and more than 20% of the country's gross domestic product (GDP). Based on the study of Mongolia's mineral export logistics system, this paper puts forward the use of "hub and spoke network" in its logistics system to carry out reasonable planning of its export logistics transportation activities, improve the utilization rate of resources to achieve the purpose of energy saving and emission reduction. According to the distribution of deposits, major cities and railways in Mongolia, and the investigation and estimation of relevant data, Python and Gurobi are used to solve this mixed linear programming problem. The experimental results show that the cost can be significantly reduced by using the "hub and spoke network" in the mineral export logistics system of Mongolia.

Key words: cross-border logistics; cross-border logistic; logistics system; "The Belt and Road" initiative

Optimization of Loading Clusters for Uncertain Loading Sequence

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Abstract：The efficiency of container loading at a container terminal is often restricted by the storage allocation in export yard. The whole export block used to be separated into several clusters to store export containers for different loading services. In former studies, the unit of template generated is always subblock. The concept of cluster is seldom touched. The size of clusters is more flexible than subblock. In this research, we want to find out the optimal size of loading clusters and proper solutions of export container allocation. A two objectives model is built which consider both the transportation distance and the handling congestions. We also consider the time window conflicts among different ships. It is concluded that the management goal of the loading services has a significant effect on the optimal size of the loading clusters in container allocation problem.

keywords: loading cluster; rehandling; yard management; container terminal

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货主-承运人纵向间整合策略的评价研究：以货主投资船队为例

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摘　要： 为在贸易运输中获取更大的利益和话语权，以及保证贸易运输环节的相对稳定，大货主往往投资建立自身主导的航运公司。从长远来看，这种货主主导的供应链纵向整合是否有利于货主，能否使货主有效地应对航运市场的风险等有待验证和证明。货主主导的船队因为具有垄断性，因此必然会给航运市场带来一定的干扰，这种干扰对整个航运市场的影响效果也尚未得到认知。为此，本文建立分析模型，研究货主供应链纵向整合的效用，探究跨周期的货主选择三种贸易运营模式（货主独资船队运营、货主与船公司合资船队运营以及第三方船队运营）的收益；明确货主供应链纵向扩张行为对航运市场的影响。最后，运用实证研究测试分析模型的适用性，并为货主的供应链纵向扩张选择提供建议。

关键词： 供应链纵向整合；货主-承运人；货主船队

Evaluation of the Shipper-Carrier's Vertical Integration Strategy: A Case Study of Shipper Investment Fleet

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Abstract：

　　In order to gain more benefits and discourse power in trade and transportation, and to ensure relative stability of transportation sector, shippers often invest in establishing their own shipping companies. In a long run, whether shippers can benefit from the vertical integration of supply chain led by themselves, and effectively respond the risks of shipping market, needs to be verified and proved. In addition, due to monopoly, the shipper-owned fleet also inevitably interferes with the shipping market, and the impact on the whole shipping market is still unclear. To this end, this paper develops an analytical model with a focus on the utility of shipper's vertical integration, by clarifying shipper's benefits of three operation modes in cross-period (shipper owned fleet mode, shipper-carrier joint fleet mode, and third-party fleet mode). Meanwhile, this study identifies the impact of shippers' vertical expansion behavior on the shipping market. Finally, empirical studies are conducted to test the applicability of our analytical model, and suggestions for shippers' choice of vertical expansion are given.

keywords: vertical integration of supply chain; shipper-carrier; shipper investment fleet.

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战略叠加效应下苏皖豫"水联网模式"概念性论述

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摘 要：在"一带一路"、"淮河生态经济带"和"长三角一体化"等多重国家战略叠加条件下，从航道网建设和联网布局的角度出发，提出苏皖豫地区发展的"水联网模式"。通过对地区的战略解析、水运网的连通布局、优劣势的比较、协调管理运维的规划，对"水联网模式"进行概念性论述，为该地区通江达海，深度发挥战略优势，联动实施战略落地提供借鉴和参考。

关键词：战略叠加；苏皖豫；水联网模式；航道联网；通江达海

Concept of " Water Network Mode " of Jiangsu, Anhui and He'nan Provinces Under Strategic Superposition Effect

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Abstract：

　　Under condition of strategic superposition of "the Belt and Road", "the Huaihe Ecological Economic Belt" and "the Yangtze River Delta Integration", from the view of channel network construction and network layout, the concept of "Water Network Mode" of Jiangsu, Anhui and He'nan provinces is proposed. Through the strategic analysis, water transport network layout, comparison of advantages & disadvantages and planning of coordinated management & maintenance of such region, the concept of "Water Network Mode" is discussed, which provides the reference to arrival to river and sea, deep achievement of strategic advantage and joint implementation of strategies in this region.

keywords: strategic superposition; Jiangsu, Anhui and He'nan provinces; water netwrok mode; channel network; arrival to river and sea

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港口群资源整合模式设计研究——以河北港口群为例

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摘　要：本文从港口群的角度出发，从港口群资源整合的内涵出发，分析港口群资源整合的影响因素，提出基于竞争影响力模型、生态位态势模型、生态位重叠模型的港口群资源整合主导主体选择、资源整合路径设计、整合紧密程度估算的模式设计方法，并以河北省港口群为例，进行港口群资源整合的实例分析，为河北及我国港口群的协调发展以及资源的优化配置提供建议。本文成果为港口群资源整合模式的设计提供了方法，为我国港口群资源整合运作提供了理论支撑，促进我国"一带一路"建设与发展。

关键词：港口群；资源整合；模式设计；河北

Research on Port Group Resource Integration Model Design-A Case Study of Hebei Port Group

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Abstract：

From the point of view of port group and from the connotation of resource integration of port group, this paper analyses the influencing factors of resource integration of port group, and puts forward the mode design method of dominant subject selection, resource integration path design and integration tightness estimation of port group resource integration based on competitive influence model, niche situation model and niche overlap model. A case study of Hebei port group resource integration is carried out to provide suggestions for the coordinated development of Hebei and China's port groups integration. The results of this paper provide a method for the design of port group resource integration mode, and provide theoretical support for the integrated operation of port group resources in China, and contribute to the construction of "one belt and one road" in China.

keywords: port group; resource integration; pattern design; Hebei

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关于打造浙江世界级港口集群行动纲要的研究

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摘　要：针对打造浙江世界级港口集群的重要意义，确定基本原则和总体目标，并提出发展格局、软硬件体系、全球贸易等方面的主要任务，最后提出保障措施。

关键词：港口集群；国际强港；一体化；世界级港口群

Research on the Framework of Action for Building a World-Class Port Cluster in Zhejiang

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Abstract：

In order to establish the significance of Zhejiang's world-class port cluster, determine the basic principles and overall objectives, and propose the main tasks of development pattern, software and hardware system, global trade, etc., and finally propose safeguard measures..

keywords: port cluster; international strong harbor; integration; world class port group

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Port Entry Pattern in East Asia: Terminal Involvement and Spatial Impacts on Port Choice

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Abstract：This paper examines how container shipping lines＇involvement in terminal operation and spatial relation among ports could impact on their port choice. The paper collects information of routes that connect East Asia with other regions in 2018 and the corresponding shipping line, route, port and hinterland data. Different spatial variables are constructed to reflect the spatial impacts among port-of-calls. Our probit model suggests that carriers are likely to select ports they are involved, regardless via themselves or via their alliance partners. Beyond that, carriers tend to call at more than one ports when serving East Asia port clusters.

Key words： port choice; vertical integration;container shipping; spatial dependence

浙江沿海港口岸线资源利用现状分析与对策建议

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摘　要：本文在对浙江沿海港口岸线利用现状调查基础上，重点对港口岸线利用效率和效益情况进行深入分析，剖析港口岸线资源配置和利用管理等方面存在问题，提出相应对策建议，为行业管理部门提供参考。

关键词：港口岸线资源；利用效率；利用效益

Research on the Current Situation Analysis and Countermeasure Suggestions of Coastal Port Coastal Resources Utilization in Zhejiang Province

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Abstract：

Based on the investigation of the current situation of coastline utilization in Zhejiang coastal ports, this paper focuses on the in-depth analysis of the efficiency and benefit of coastline utilization, analyses the existing problems in the allocation and utilization management of port coastline resources, and puts forward corresponding countermeasures and suggestions to provide reference for industry management departments.

keywords: coastline; efficiency; benefit

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Competition or Cooperation? Ports'Strategies and Regulation in a Shipping Alliance Ara

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Abstract：This paper investigates the strategic reaction of ports when they face the pressure from the shipping alliance. A three-stage game model is established to analyze the strategy choices of the shipping lines (competing or making alliance) and the ports (behaving independently, making horizontal cooperation or making vertical cooperation). The Nash Equilibrium is derived analytically in a symmetric case where the shipping lines and the coastal/inland ports are symmetric with each other. The results indicate that (1) the horizontal cooperation of the ports cannot improve their profits compared to their independent behaving; (2) when the inland ports' efficiency is lower and the capacity investment cost is higher, the ports are inclined to choose the vertical cooperation; (3) when the competition effect is stronger (or weaker, respectively) than the synergy effect, the shipping lines choose to make alliance (or compete with each other, respectively). Moreover, we investigate the government's regulation on ports' capacity investment decisions.

Key words：competition; cooperation;shipping alliance; port governance

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Inland Shipping Network of LNG-Fueled Ships Under Emission Control- the Case of China's Belt and Road Shipping Corridor Along the Yangtze River

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Abstract：Liquefied natural gas (LNG) is used as an environmentally friendly source of fuel for inland river shipping in selected markets. However, the investment costs for bunkering stations and the price volatility of LNG have prevented it from being used more widely. In this study, we investigate the operation of LNG-fueled shipping in an inland river network, taking into account the effects of emissions regulations, the bunkering station locations, the price competitiveness of LNG, and the heterogeneity of the navigational conditions in inland rivers. The model is used to study bulk-cargo transportation along the Yangtze River, a major inland waterway of growing importance due to the Chinese government's Belt and Road initiative. The modeling results suggest that the optimal shipping operations and bunkering station locations are significantly affected by the emissions regulations and incentive policies. In the Yangtze River market studied, low-sulfur fuels are the preferred option for carriers at a wide range of emission control levels. However, LNG only becomes an attractive fuel option when the emissions cap is set significantly below the current emissions level. For the promotion of LNG-fueled shipping, unit fuel subsidies are more effective than lump-sum capital subsidies for bunkering stations when the LNG price is high. However, the availability of bunker stations is an important factor when the LNG price volatility is considered. Overall, our results suggest that although LNG-fueled shipping is a promising option in the long term, the optimal industry policy on fuel use is dependent on multiple factors including the fuel price, types of subsidy, and emissions targets.

Key words：LNG-fueled shipping;inland waterway;green shipping;bunkering station choice; belt and road initiative

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中美贸易冲突对中美集装箱运量的影响及区域差异研究

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摘　要：美国发动对中贸易战的主要手段是对中国出口到美国的商品加征关税，从而降低中国产品在美国市场的竞争力，减少中国出口到美国的数量。这种贸易冲突的后果在航运市场的体现是中美之间的贸易运输量减少，导致中美航线的运力需求与供给关系失衡，进而波及到全球的航运市场。为定量分析中美贸易摩擦对航运业尤其集装箱海运业的影响，本文基于价格弹性，研究中美贸易集装箱运量的变化及中国不同门户港集装箱吞吐量的变化。为此，首先根据 2003-2017 年中美贸易数据，运用固定效应面板模型测算不同类别商品的出口价格弹性，确定价格变化与商品出口量变化之间的关系；其次，基于《商品名称和编码协调制度》（即 HS 标准）识别对美贸易的适箱商品，并基于价格弹性预测中美贸易冲突对中美集装箱运量的影响；最后，考虑到我国不同区域产业结构的差异，以环渤海区域、长三角区域和珠三角区域为对象，研究中美贸易冲突对不同区域集装箱运量以及港口吞吐量的影响。本研究有助于决策者充分认识中美贸易冲突对我国航运业的影响，为提出切实有效的应对之策奠定基础。

关键词：中美贸易冲突；集装箱运量；价格弹性；区域差异

Research on the Impact of Sino-US Trade Conflict on Sino-US Container Transportation Volume and Its Regional Differences

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Abstract：

The main way for Sino-US trade war launched by the United States is to impose extra tariffs on Chinese exports to the United States, thereby reducing the competitiveness of Chinese products in the American market and decreasing the number of Chinese exports to the United States. The consequence of this trade conflict is the reduction of trade volume between China and the United States in the shipping market, resulting in an imbalance between the capacity demand and supply of the Sino-US routes, which in turn affects the global shipping market. In order to quantitatively analyze the impact of Sino-US trade conflict on the shipping industry, especially the container shipping industry, this paper studies the changes in Sino-US container transportation volume and the changes in container throughput of different ports in China based on price elasticity. First, based on Sino-US trade data from 2003 to 2017, a fixed-effect panel model is used to estimate the export price elasticity of different types of commodities. The relationship between price changes and changes in commodity exports is determined. Then, after containerized cargo identification based on HS standard, the impact of Sino-US trade conflict on Sino-US container transportation volume can be quantitatively analyzed in the light of price elasticity. Finally, taking into account

the differences of industrial structure in different regions of China, the impacts of Sino-US trade Conflict are investigated on container transportation volume and port throughput in different regions, including bohai region, Yangtze River Delta region and Pearl River Delta research. This research helps decision makers fully understand the impact of Sino-US trade conflict on China's shipping industry and lays the foundation for putting forward effective solutions.

keywords: Sino-US trade conflict; container transportation volume; price elasticity;regional differences

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Scenario-Based Cost-Effectiveness Analysis of Ballast Water Treatment Strategies

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Abstract：strategies considered unfeasible to achieve global and regional ballast water discharge regulations. The main goal is to achieve the regulated standards with appropriate technology, and at the same time, minimize the compliance cost to reduce the burden on the shipping industry. Three potential regulations are examined, given the complexity and uncertainty of current regulations. The results show that the required numeric standards matter a lot. If a single global standard is a weak standard, then adopting vessel-based compliant technology is less costly than centralized barge-based compliance. If some region or all regions adopt stricter standards, barge-based systems can be a way to implement stricter compliance. The findings reveal the potential role of barge-based treatment measure. The increased $0.7 billion compliance cost for the U.S. to achieve stricter ballast water regulation per year may inform more careful decision-making process.

Key words：ballast water management;cost-effectiveness analysis;compliance strategy; barge-based;vessel-based;scenario-based

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Container Vessels Diversion Pattern to Trans-Arctic Shipping Routes and CO₂ Emission Abatement Potential

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Abstract：Climate change opens trans-Arctic navigation routes. Recognized opportunities exist for viable trans-Arctic shipping routes due to possible reduced distance and sailing time, while potential environment impacts and risks due to increased shipping traffic also rise. Future trans-Arctic shipping diversions require analysis of voyage time-savings, potential cost-reductions and environmental performance. This article develops two general shipping traffic diversion models customized to container vessels to study their diversion pattern with the goal of least shipping duration and goal of least shipping cost. We include discussion about how trans-Artic diversions could serve CO_2 emission reduction goals agreed by International Maritime Organization member states, and the impact of a policy scenario that may include the shipping industry in Emissions Trading System. Results show a small number of shipping voyages may benefit from diversion to trans-Arctic routes. Trans-Arctic voyage diversions reduced distance transit between 36 different routes/port pairs. Of the 36 routes with shorter trans-Arctic distances, 19 would also save sailing time. Of the 19 routes that would save time using trans-Arctic routes, 12 would reduce cost and CO_2 emissions. One more port pair could also become economically viable if reimbursed under a CO_2 emissions trading scheme using recent carbon prices..

Key words： Arctic shipping; diversion pattern; distance model; cost model; CO_2 emission; emission trading system

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Impact Analysis on Liner Transport Under Emission Control and Speed Limit

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Abstract：This paper formulates an integrated containership speed optimization model under emission control, aiming to examine the environmental effects of optimization strategies for the green growth of international container shipping. Taking a comprehensive perspective of designated zone, compulsory sulfur and GHG emissions as well as speed reduction policy, the proposed model explicitly incorporates all aspects of voyages inside and outside of emission control areas (ECAs) and reduced speed zones (RSZs), capturing key container ship operational considerations, such as line schedule, fuel consumption, fuel price, designed maximum speed, and emission control. Optimum containership speed strategies under different objectives, such as least amount of emission, lowest fuel consumption and cost inside and outside ECAs and RSZs are derived. A case study of the CSCL Pacific Ocean sailing from the Far East (Shanghai, China) to North-eastern Europe (Gdansk, Poland) is provided to illustrate the results.

Key words：containership; emission control; speed optimization; liner schedule; environmental effect

全球船舶硫排放控制的比较和对中国限硫方案的建议

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摘　要：近年来，随着人们环保意识的逐年提高，社会各界对船舶大气污染的关注度也日益增加，为此，全球多个区域专门设立了船舶排放控制区，对控制区的船舶提出更为严格的大气排放要求。中国已于 2015 年 12 月设立了船舶排放控制区，并于 2018 年 7 月发布征求意见稿，计划进一步强化排放要求。本文主要是通过比较全球船舶排放控制区的硫限要求和政策措施，得出适合我国国情的要求和措施，并在此基础上对下一步的中国硫限方案提出建议。

关键词：排放控制区；硫限；2020

Comparison of Global Ship Sulphur-Limit and Suggestions for Ship Sulfur-Limit Policy in China

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Abstract：

In recent years, as people's awareness of environmental protection has increased year by year, the public's attention to the air pollution of ships has increased. For this reason, ships＇ emission control areas have been set up in many regions around the world, and ships in the control areas are required more stringent emission control. China has established a ship emission control area in December 2015 and issued a draft for comments in July 2018, with plans to further strengthen emission requirements. This paper mainly compares the requirements and measures of the sulfur limit of the global ship emission control zone, and draws the requirements and measures suitable for China's national conditions. Based on this, it proposes the next sulfur limit plan for China.

keywords: emission control area; sulphur limit; 2020

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限硫令：行业如何齐步走

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摘　要：本文主要介绍了"MARPOL 附则 VI 第 14.1.3 条的一致性实施指南"的制定进程，并分块介绍了该指南草案的具体内容，该指南是全球经验的"结晶"，对该指南的解读有利于推进各行业对 2020 年限硫令的理解和应对实施。

关键词：限硫令；2020；一致性实施

Sulfur Limit Policy: How the Industry Goes Hand in Hand

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Abstract：

This paper mainly introduces the development process of "Guidelines for Consistency Implementation of Article 14.1.3 of MARPOL Annex VI", and introduces the specific content of the draft guide, which is the "crystallization" of global experience. Interpretation is conducive to promoting the understanding and response of marine industry to the 2020 sulfur limit.

keywords: sulphur limit policy; 2020; consistency implementation

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由经验积累期谈压载水公约和限硫令当前问题和对策

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摘　要：本文基于当前国际海事组织关于压载水公约和限硫令的会议讨论情况，从"经验积累期"概念的角度出发，探索当前对航运界影响深远的上述两项热点政策之间的联系和区别，并联系实际找出了两者当前的问题，同时提出了笔者的解决建议。

关键词：经验积累期；压载水公约；限硫令

Talking About the Current Problems and Countermeasures of the Ballast Water Convention and the Sulfur Limit from the Experience Building Phase

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Abstract：

Based on the current IMO discussions on Ballast Water Convention and sulfur limit policy, this paper based on the concept of "experience building phase", explores the links and differences between the two hotspot policies that have far-reaching impact on the shipping industry. And contact the actual, find out the current problems of the two issues, and at the same time put forward the author's solutions.

keywords: experience building phase; Ballast Water Convention; sulphur limit policy

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The Current Problems and Countermeasures of the BWM Convention and the Sulphur Limit Policy Based on the "Experience-Building Phase (EBP)"

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Abstract：This paper begins with a discussion of setting up an "experience-building phase" for the 2020 sulphur limit policy at the MEPC 73 session, and discusses the main issues and countermeasures of the current Ballast Water Management (BWM) Convention and the sulphur limit policy. Through comparative analysis, it can be found that, although the BWM Convention had already entered into force, many problems such as ballast water sampling had not been resolved and needed to be resolved through setting up an "experience-building phase". In contrast, the problems of sulphur limit policy are mainly the safety and availability of fuel oil. There already have some corresponding measures for them, so it is not recommended to set up a similar "experience-building phase" for the sulphur limit policy.

Key words: experience-building phase (EBP); Ballast Water Management (BWM) Convention; sulphur limit policy

Fleet Deployment and Speed Model in Liner Shipping with Sulphur Emission Control Areas

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Abstract: Recently, the shipping Sulphur oxide (SOx) emissions have accounted for approximately 13% of global SOx emissions, and the emissions are related to the health of the residents near coastlines. International Maritime Organization (IMO) requires the maximum permitted Sulphur content of fuel falling to 0.1% from January 1, 2015 within the four Sulphur Emission Control Areas (SECAs), including the Baltic Sea, the North Sea, the North American coasts and the US Caribbean. However, Chinese SECAs may still set 0.5% as the criterion according to Ministry of Transport (MOT) in China. Moreover, the scope of seas enclosed by geodesic line is only 12 nautical miles in China, while the width in EU will be set at 200 nautical miles from 2020, much wider than those of China. To improve the emission efficiency and operational performance for liner shipping in SECAs, this paper proposed a fleet deployment model for liner shipping under SECA Sulphur regulations, with the objective to minimize the total cost, including fuel consumption, fixed cost, cost of chartering in ships, etc. This allows examining the implications of the total cost to SECA Sulphur regulations, and the influence the fleet deployment in SECAs may have. To solve the proposed model, the equaling sailing speeds of various ships on one liner route were first relaxed, and then the cost-minimizing speeds of various ships inside and outside the SECAs on one liner route were investigated. Next, a branch and bound algorithm is used to solve the model with optimization speeds. Finally, sensitivity analyses on different scopes of seas enclosed by geodesic line are conducted, which could provide guidance for whether to extend the geographical scope of SECA, especially in China.

Key words: Sulphur Emission Control Area; Liner Shipping; Cost-minimizing Speed; Fleet Deployment; Enlargement of SECA

集装箱海运网络韧性评价研究——以海上丝绸之路为例

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摘 要：本文基于复杂网络理论和"韧性三角"提出了一种海运网络韧性评价框架模型，实现了对集装箱海运网络在自然灾害下抗毁性和恢复性的定量评价。在该韧性评价框架中，通过分析海运网络的脆弱性和不同恢复策略下的表现综合分析海运网络的韧性。其中，脆弱性通过网络效率及最大连通子图相对大小的变化来衡量。航运网络部分中断到完全恢复的过程中，将海运网络的恢复能力与韧性三角形相关联，利用全局网络效率反映整个海运网络韧性的变化情况。将提出的韧性评估方法用于台风灾害下的海上丝绸之路海运网络，并对比随机恢复策略和基于综合中心恢复策略下海运网络功能恢复的差异。研究结果表明与随机恢复策略相比，基于综合中心性的恢复策略可有效地提高海运网络的韧性，该结论可为海上运输风险管理提供参考，提高海运网络的安全性和可靠性。

关键词：集装箱海运网络；海上丝绸之路；交通系统韧性；综合中心性；海上风险

Resilience Assessment of Maritime Container Shipping Networks-A Case of the Maritime Silk Road

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Abstract：

This paper presents a framework for the resilience assessment of maritime shipping networks by quantifying its recovery performance under natural hazards. The vulnerability of the maritime shipping network is measured according to the variation of network efficiency and the relative size of the largest connected subgraph in the face of the disruption of transportation systems (shutdown of ports). The service performance of the maritime shipping network is indicated by the global network efficiency, and the resilience of maritime shipping network is associated to the network performance loss triangle considering the whole process from a partial disruption to full recovery. The proposed resilience assessment method is applied to a container shipping network of the Maritime Silk Road (MSR) under the storm risks. Two recovery strategies, which are random recovery strategy and multi-centrality based recovery strategy, are adopted respectively, and the recovery performance of the container shipping network under different strategies are comparatively analyzed. The research results can be used to support the identification of the weak points of the maritime transportation network along the MSR through vulnerability analysis and can provide a reference for the effective risk management of maritime shipping as well, so as to improve the safety and reliability of the whole system.

keywords: container shipping network; the Maritime Silk Road; transportation resilience; multi-centrality; maritime risk

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港口集疏运系统研究综述

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摘　要： 高效的集疏运系统对于港口发展非常重要。本文全面分析了港口集疏运系统建模与优化的国内外研究现状，理清了该方向研究的总体脉络，总结了国内外研究的侧重点。最后给出了该方向今后的研究趋势。本文研究对于港口集疏运系统建模和优化研究具有参考价值。

关键词： 港口，集疏运系统，研究综述，研究趋势

Review of Port-Hinterland Multimodal Transport System Model

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Abstract：

Efficient port-hinterland multimodal transport system is very important for the development of a port. This paper comprehensively analyzes the domestic and foreign research status of modeling and optimization of port-hinterland multimodal transport system, clarifies the overall context of the researches in this direction, and summarizes the focuses of domestic and foreign studies. Finally, the future research trends in this field are given. This study is of reference value for future studies on the modeling and optimization of the port-hinterland multimodal transport system.

keywords: Port; Port-hinterland multimodal transport system; Literature review; Future work

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Collaborative Reliability Analysis of Underground Container Logistics Collection and Distribution System Based on Fault Tree and Fuzzy Stochastic Petri Net

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Abstract：With the trend of large-scale and diversified development of ports, the traditional port land collection and distribution system, which is mainly based on road transportation such as highways, has an increasingly sharp contradiction in port and city traffic. Meanwhile the emergence of underground container logistics and transportation system, it can greatly improve the conditions of the city's traffic. As a subsystem of the container collection and distribution system, the underground container logistics and transportation system is independent and closely related to other subsystems. Based on the definition of collaborative reliability of the underground container logistics collection and distribution system, this paper analyzes the characteristics and reliability of the underground container logistics collection and distribution system. The paper establishes fault tree and fuzzy random network method to study the reliability of underground container collection and distribution system coordination qualitatively and quantitatively, and introduces fuzzy set theory to blur the elements of all transfer matrix in system steady state probability equations. The matrix equations are finally declassified by the reliability index. The results of the collaborative reliability of the underground container logistics collection and distribution system are obtained, which serves as a theoretical basis for the collaborative research of the underground container logistics collection and distribution system.

Key words: underground logistics; collection and distribution; system theory; coordination; fault tree; fuzzy stochastic Petri net

Estimation of System Carrying Capacity Considering Underground Logistics

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Abstract：The logistics network carries the flow of goods and things throughout the system, and the logistics network capacity of the system represents the carrying capacity of the entire system. In recent years, the research on underground logistics system has been gradually deepened. In order to comprehensively measure the overall carrying capacity of the whole system, this paper considers the underground logistics and ground logistics at the same time, and combines the components of the system carrying capacity and the operation process. Based on the capacity of the road section and the ability of operation, the calculation model of the system's carrying capacity is constructed, and the data of Shanghai is used to analyze the example to verify the validity of the model.

Key words：carrying capacity; logistics system; underground logistics; OD structure; network capacity

Container Trucks Scheduling Research Considering Simultaneous Loading/Unloading in the Underground Container Logistics System (UCLS)

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Abstract： With the rapid growth of containers and shortage of ground land resources, the underground container logistics system (UCLS) is a better choice for container terminals to improve environment and relieve traffic pressure. In addition, the operating efficiency of container terminals is one of significant factors for competition with other terminals. Therefore, it is crucial to connect the UCLS and ground yard storage. In UCLS, yard trucks can serve for different handling points flexibly instead of one fixed handling point. With the aim to minimize the makespan of all containers in UCLS, the mixed integer programming problem considering loading and unloading simultaneously is described and solved via adaptive genetic algorithm (AGA) in this paper. Finally, the convergence speed and accuracy of AGA are demonstrated by conventional GA in this paper. AGA and CPLEX are compared with different scale problems. Experimental results show that the proposed algorithm is superior to CPLEX in solution results and calculating time.

Key words: underground container logistics system; loading and unloading simultaneously; mixed integer programming; adaptive genetic algorithm

Design of a Novel Underground Parking Lot for Container Logistics System

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Abstract：In this paper, an underground container logistics system (UCLS) between Shanghai Waigaoqiao Terminal and Jiading Northwest Logistics Park is proposed to relieve the ground traffic pressure caused by container trucks in a port. Furthermore, in order to guarantee the connection between the UCLS and the yard behind the ground terminal, a design of an underground parking lot in the system is also proposed. The underground parking lot is a buffer used for the loading and unloading of underground guided vehicles (UGVs). A mixed integer nonlinear programming model (MNIP) for UGVs and yard cranes in the underground system is formulated to minimize the total cost of UGVs waiting and yard cranes. Then, the optimization model is solved via MATLAB software. With sensitivity analysis, the number of loading and unloading points in the underground parking lot is optimized for the purpose of minimizing the total cost. Finally, a simulation experiment is carried out to obtain the optimal configuration of the number of loading and unloading points and the arrival rate in the UCLS.

Key words: underground container logistics system; underground parking lot; design; optimization; simulation

长三角一体化下浙江海河联运运输体系发展研究

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摘　要：在分析浙江海河联运发展现状的基础上，结合长三角一体化的发展要求，预测了浙江煤炭、集装箱两大货种海河联运的货运量，并根据海河联运的经济性提出了浙江煤炭、集装箱海河联运合理运输体系，对浙江海河联运中影响系统高效运转的关键问题提供了解决措施，为浙江海河联运高质量发展提供决策依据。

关键词：长三角一体化；海河联运；运输体系

Research on the Development of Zhejiang Sea-River Combined Transport System in Yangtze River Delta Integration

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Abstract：

This paper analyzed the current development of sea-river combined transport and predicted the freight volume between sea and river of cargo and container in Zhejiang province combining the requirement of Yangtze River Delta Integration. And the reasonable transport system between sea and river of cargo and container was put forward based on the economy. Finally, the solution on the major problem was figured out that affected the efficient operation of sea-river combined transport, which provided the decision-making basis for the high-quality development of sea-river combined transport in Zhejiang province.

keywords: Yangtze River; sea-river combined transport; transport system

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Efficient Large Scale Spatiotemporal Data Compression and Pre-Processing for Facilitating Big Spatiotemporal Data Mining-A Case Study Based on AIS Data

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Abstract： With the wide utilization of sensors and GPS systems recording objects' movements, large scale spatiotemporal data are accumulated. The large scale data facilitate the understandings of vessel movement trajectories and activities. However, it is very challenging to store, transfer and load such large volume of spatiotemporal data into system memory. In this study, we look into a study case that processes large scale of AIS data in maritime sector, and propose a computational framework to efficiently compress, transfer and acquire necessary information for further data analysis. The framework is composed of two parts: The first is a lossless compression algorithm that compresses the AIS data into binary form for efficient storage, speedy loading and easy transfer across networks and systems within the organization; the second is an aggregation algorithm which derives movement and activity information of vessels grouped by grid and/or time window from the compressed binary files. The aggregation algorithm compresses and organizes data by vessel ID, thereby improving accessibility, and reducing storage demand. The proposed framework has been applied to extract vessel movement information within Singapore port with high compression rate and fast access speed, and it can be extensively applied for other data processing applications.

Key words: AIS Data

Identifying Bottlenecks of the Shipping Network in the Context of China's Maritime Silk Road Initiative

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Abstract： The 21st Century Maritime Silk Road (MSR) initiated by China involves construction of a new form of regional economic cooperation between China and the associated countries. Priority is given to eliminating maritime bottlenecks and building an efficient maritime transport network between the countries along the MSR. However, such potential bottlenecks have rarely been measured quantitatively. In this paper, we present a recursive spectral bi-partitioning method to detect the potential bottlenecks in the shipping network along the MSR. This method identifies the bottlenecks by locating the cuts with least total link frequency, normalised by the size of the subnetworks on either side of the cut. Results of the case study show that the proposed method performs well. Four bottlenecks with strategic geographical positions along the key trading area are found, namely; Suez Canal, Cape of Good Hope, northern Oceania, and South China Sea, indicating locations in need of connectivity improvement.

Key words： bottleneck identification; 21st Century Maritime Silk Road; spectral analysis; shipping network

Behind the Scenes: Research & Development for Singapore Next Generation Port

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Abstract： As the scale and complexity of container ports keep growing, more sophisticated, scientific and intelligent methods are required to support the planning and operation in next generation ports. As one of the world's top container ports, Singapore has put in place the Next Generation Port 2030 Initiative to continue delivering world-class services and retain its global leading position.

As a part of Singapore maritime society, the Centre of Excellence in Modelling and Simulation for Next Generation Ports in the National University of Singapore has been established to help Singapore's maritime and port industries, develop innovative capabilities and enhance their global competitiveness.

In this talk, we will introduce the core capability – how to integrate and implement simulation and optimization for the next generation ports, and share the latest research and development for the maritime and port industry, such as automated guided vehicle and autonomous truck related development, storage yard planning strategy, sea channel and berthing management, etc. Finally, we will share the future roadmap of the centre and Singapore maritime development.

Key words： Next Generation Ports; Research and Development; Singapore Port; Port Operation and Management

Comparison of Four Different Operation Models of Container Terminal from Carbon Footprint Perspective

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Abstract：Main purpose of this paper attempted to explore CO2 emission produced by four different operation models of container terminal (e.g. Tire Transtainer, Electric Tire Transtainer, Rail Transtainer, Automatic Rail Transtainer) in the port of Kaohsiung, and figure out the strategies of energy saving and CO2 reduction for shipping company or terminal operator in compliance with the requirements of green port.

This paper's research methodology involves carbon footprint analysis and gray relational analysis. Carbon footprint analysis is employed to calculate the CO2 emissions per container of four different container handling equipment models employing data for various areas (such as the berthing area, container yard, and gate area). Gray relational analysis is then used to determine the ranking order of different container handling equipment models based on the green port assessment criteria of working time efficiency, energy consumption cost, and CO2 emissions. The paper's main findings are as follows: (1) Ranking order of CO2 emission volume based on carbon footprint approach appeared TT>ART>RT>E-TT; (2) E-TT could save approximately 64.71% of energy consumption cost in comparison with TT;（3）RT and E-TT can be considered green cargo handling equipment due to their significant contributions to working efficiency, energy saving, and CO2 reduction.

Key words：port; carbon footprint; container terminal; grey relation analysis

基于 LSTM 网络的船舶交通流量预测模型

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摘　要：为更加准确地把握船舶交通流量的变化趋势并提高交通流量的预测精度，本文提出了基于 LSTM 网络的船舶交通流量预测模型。首先将原始船舶交通流量数据进行归一化处理并将归一化后的数据置入长短时记忆(Long Short-Term Memory, LSTM)型递归神经网络模型进行训练，然后将待预测的数据输入到已经训练好的网络模型中得到预测结果，最后对比实际值与预测值、分析误差和仿真结果。实验结果表明，在深圳港数据实例下的 LSTM 模型预测船舶交通流量的均方误差(MSE)相比于 SVM 降低了 1%，比传统的 BP 神经网络降低了 2%。进而验证了深度学习循环神经网络预测模型在船舶流量预测中的有效性，对港口船舶交通组织具有研究意义。

关键词：船舶交通流量预测；递归神经网络；LSTM；深度学习

Forecast Method for Ship Traffic Flow Based on RNN

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Abstract：

　　In order to more accurately grasp the changing trend of vessel traffic flow and improve the prediction accuracy of traffic flow, an improved model was introduced to predict ship traffic flow based on the long-short term memory - recurrent neural network(LSTM-RNN). Firstly, the raw data is normalized and the LSTM model is established based the normalized data. Finally, compare the predicted value with the actual value to analyze the error and simulation results. The results show that compared to SVM, Mean square error (MSE) was declined by 1% and compared to BP Neural Network, was decreased by 2%. Further, the feasibility of LSTM of deep learning that is to predict ship traffic flow was verified and it has a broad application prospect in the field of traffic prediction of ships.

keywords: ship traffic flow; forecasting; recurrent neural network; LSTM; deep learning

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A Simulation-Based Method for Analysing Energy Demands in Container Terminals Under Different Arrival Interval of Ships

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Abstract：The contribution of this paper is to provide a simulation-based method to analyze the highly dynamic energy demands in container terminals under different arrival interval of ships. In order to overcome the complicated and stochastic operation processes in container terminals and obtain the energy demands at each time step, a simulation model is established. Then, various simulation models based on a container terminal in Northeast China are developed and carried out to study the impact of arrival interval of ships on energy demands. Finally, the energy demands in the container terminal are obtained and analyzed after running the simulation models. The results indicate that the energy demands represent a high randomness and large variations. When arrival interval changes from 5 h to 10 h, there is a sharp fall in the daily average energy demands, while as arrival interval changes from 15 h to 20 h, the daily average energy demands mainly concentrate between 0 MW and 1 MW. The obtained results and proposed method can provide references for power department policy making and balancing energy supply and demand in container terminals.

Key words：Green port; energy demands; simulation-based method; container terminal

基于改进 GM（1,1）模型的厦门港发展预测研究

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摘　要：港口作为城市群对外经济贸易的通道，是体现城市综合竞争能力的重要平台。对影响港口发展的典型因素和吞吐量进行研究，有助于对港口未来发展做出合理预测。运用 GM（1,1）模型和弱化缓冲算子改进 GM（1,1）模型分别对厦门港典型因素、吞吐量进行预测分析，结果表明改进 GM（1,1）模型精度更高，并根据预测结果提出相应发展建议。

关键词：港口发展预测；改进 GM（1,1）模型；弱化缓冲算子

Study on Development Forecast of Xiamen Port Based on Improved GM (1,1) Model

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Abstract：

　　As the channel of foreign economy and trade of urban agglomeration, port is an important platform to embody the comprehensive competitive power of city. The typical factors and throughput that affect the port development are studied, which is helpful to make a reasonable prediction for the future development of the port. The GM (1,1) model and the weakening buffer operator improved GM (1,1) model are used to predict the typical factors and throughput of Xiamen Port. The results show that the improved GM (1,1) model is more accurate, and the corresponding development suggestions are put forward according to the prediction results.

keywords: Port development forecast; Improved GM (1,1) model; Weakening buffer operator

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远东码头非常规潮水向右掉头靠泊探讨

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摘　要：宁波港穿山港区集装箱码头对开，在螺头水道急落水时存在着里涨外落的潮流，在此期间虾峙门方向进来靠泊的船舶一般均选择向左掉头右舷靠涨水。但是由于潮汛的不同，涨水区域的大小也存在着较大差异，给船舶掉头带来了一定的困难。本文结合平时工作中实际操作，以及穿山集装箱码头前沿潮流特点，以远东八号泊位为例，介绍一下在码头边沿向右掉头右舷靠泊的方法，与大家共同探讨。

关键词：切变线；非常规潮流；偏转；回流区

Discussion on Turning Right and Berthing at Far East Container Terminal During Unconventional Tide

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Abstract：

There is a trend of fall and floodnear Container terminals in Chuanshan Port Area of Ningbo Port when it falls sharply in the Luotou channel. During this period, ships entering and berthing in the direction of Xiazhi generally choose to turn to port and to starboardsidealongside. However, due to the difference of tide , the size of flooding area also varies greatly, which makes it difficult for ships to turn around. Based on the practical operation in peacetime and the characteristics of the tidal current in the front of the pier, taking berth No. 8 in the Far East as an example, this paper introduces the method of berthing on the starboard side , turning right at the edge of the pier, and discusses with you.

keywords: shear line; unconventional tidal current; deflection; reflux zone

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基于双因素理论的引航服务质量提升路径

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摘　要：港口的快速发展，港口对安全和效益的要求越来越高，船舶的大型化，通航环境日趋严峻，都对引航服务质量提出了更高要求。在提高引航服务质量的过程中，可以借鉴赫茨伯格的双因素理论，分别从引航服务中的保健因素和激励因素着手，切实提高引航员的技术水平和服务能力，保障船舶引航安全，提升引航服务质量，提供让船方满意的高质量引航服务。

关键词：引航；双因素理论；引航服务质量

The Improvement Path of Pilotage Service Quality Based on Two-Factor Theory

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Abstract：

The rapid development of the port, the demand for security and efficiency of the port is getting higher, the ship's great shape, the navigation environment is getting worse, all of which have put forward higher requirements on the pilotage services quality. In the process of improving the pilotage service quality, we can learn from hertzberg's two-factor theory and start from the health and incentive factors in pilotage service, so as to effectively improve the technical level and service ability of pilots, guarantee the safety of pilotage, improve the quality of pilotage service, and provide high-quality pilotage service to the satisfaction of the ship.

keywords: pilotage; two-factor theory; pilotage services quality

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