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The autonomous collision avoidance system on trial

AUTONOMOUS NAVIGATION THE NEXT GREAT STEP

Milestone for the autonomous navigation system (ANS) developed at CML: In May, the system was tested under real conditions on a multi-day voyage calling three ports in the Mediterranean. The ANS was installed on the bridge of a container ship of Bernhard Schulte Group and connected with the on-board sensors for AIS (Automatic Identification System) and ARPA data (radar information). The goal of the ANS in the live test (previously tested only under laboratory and simulation conditions) was to observe the internationally applicable Regulati-

ons for Avoiding Collisions at Sea (COLREGs) and suggest necessary manoeuvres on an electronic navigational chart.

The collision avoidance system simultaneously tracked up to 100 vessels as well as determining the applicable COLREG rules for route alteration. Among other things, a serious situation arose during the live test due to a cargo ship crossing the ships route from the starboard side. The ANS system reliably recognised the need for an evasive manoeuvre and recommended a corresponding change of course. The chief officer of the

vessel HANNAH SCHULTE was convinced: The ANS had, just as well as in all other cases on the trip, proposed the right manoeuvres at the right time. And, the CML scientists were also pleased that this prototype has proven its worth in monitoring and guiding seagoing ships. Successful integration into the onboard systems is an important step for the development of autonomous solutions.

OPTIMISED FORECASTING OF SHIP JOURNEYS WEATHER ROUTING AND AIS-DATA ANALYSIS

Global climate protection goals, emission regulations and strong competition require sustainable and efficient forms of sea transport. Varieties of technical and operational measures with different potentials to enhance efficiency and reduce emissions are available to achieve the objectives mentioned above and thereby to stand out from the competition. The Fraunhofer CML (Center for Maritime Logistics and Services) is working on solutions to improve operative route planning: **Weather Routing** enables optimised fuel consumption sea travel. Weather routing systems optimize a voyage based on meteorological and oceanographic information taking into account ship characteristics as well as routing informati-

on. The use of efficient and robust algorithms enables interaction with other assistance systems whereby the targeted adjustment of route and speed leads to increased operational efficiency. As a result, weather routing offers great potential for use in the merchant shipping industry. At CML, these systems are also being developed to be used in innovative ship concepts, e.g. for wind driven ships, such as the sailing cargo ship design Vindskip™ as well as for autonomous ships.

Maritime transport data analysis uses big-data approaches to analyse historical and current AIS data (Automatic Identification System), which among other information include the position, the course and the speed of a

ship.

By means of the carriage requirements introduced in 2004 requiring all merchant ships to be equipped with AIS transmitters, historical data could be recorded and stored - resulting in a treasure-trove of data. At CML, the historical ship movements are correlated to its corresponding weather and environmental parameters, such as waves, currents and tides to greatly increase the accuracy of future voyage and arrival time predictions.

This is good news for player involved in operational procedures at ports, as today a large part of estimated arrival times are simply incorrect.

FOREWORD



Dear readers,

For scientists, it is truly something special to successfully see their own developments into practice. All the more when new ideas for future research emerge from a demonstration. Find out more about the practical test of our autonomous navigation system in the Mediterranean in this newsletter.

In addition, we report on the potential of Multi-Purpose terminals. These all-rounders among terminals often get too little attention, and the versatile possibilities to use their potential are simply not implemented enough. However, according to experts, Multi-Purpose terminals will benefit from changing transport structures in the coming years.

Enjoy reading

Yours, Prof. Carlos Jahn
Head Fraunhofer CML



Strong all-rounders: One of the world's largest ship propellers is loaded in the Port of Hamburg

THE OFTEN UNDERVALUED TERMINAL TYPE: MULTI-PURPOSE TERMINALS

Many Multi-Purpose terminals are the historic core of freight handling operations in ports. However, these terminals have been rather neglected when it comes to port development and optimisation as well as to research and development projects. This is reasoned since other cargo types showed higher growth rates while many port terminals specialised either in containers, RoRo transports or bulk cargo - often at the expenses of the Multi-Purpose terminals. In comparison to these terminals, which specialise in the handling of particular cargo types, Multi-Purpose terminals are distinguished by the ability to handle several cargo types providing a certain flexibility

regarding a changing demand for transshipment. Globalisation is currently experiencing a period of changing commodity flows, transport routes and modes, changes in production systems (e.g. batch size 1), new configurations of global supply chains (nearshoring/reshoring) accompanied by an increasing differentiation in products. These changes will demand a greater flexibility from terminal operators. This is a huge opportunity for Multi-Purpose terminals to increase their market share. Many of these terminals are often less technologically developed compared to other terminal types and thus should be developed further in these times of digi-

talization. This includes the deployment of new equipment and new possibilities offered by digitalisation and other recent technological advances like (semi-) automated terminal equipment or technologies for automated tracking of goods handled and stored at the terminal. The Fraunhofer CML has investigated existing and planned Multi-Purpose terminals worldwide and has derived from that research recommendations on how these terminals can be optimally planned and operated.

INTELLIGENT ALGORITHMS FOR CONDITION-BASED MAINTENANCE OF SHIP SYSTEMS

High cost pressure in the merchant shipping industry and increasing availability requirements from the charterer side require reliable maintenance of ships and their systems. This challenge can be met with optimised maintenance planning and more efficient maintenance processes. Now, mainly time-based preventive maintenance processes are carried out predominantly for different reasons. So far, condition-based maintenance (CBM) has been mainly used for ship propulsion systems. However, significant cost savings could be made on maintenance and spare parts procurement leading to roughly 25% of the ship's total operating cost. For this purpose, CML has developed a methodology for condition-based maintenance of other ship systems. The aim is to develop suitable fault diagnosis and prognosis solutions

for further ship systems such as generators, refrigeration systems and electronic components. These systems contribute a significant proportion of maintenance expenses and may lead to operational restrictions in the event of a failure. CML's approach determines the targeted selection of these ship systems as well as the development of evaluation algorithms. For this purpose, four steps are carried out: In the first step, suitable systems are identified through potential estimation and feasibility assessment as well as an analysis of relevant error types. Among other things, selection criteria include cost saving potential and data availability. The second step involves a detailed analysis of existing and newly obtained data regarding quality and suitability for CBM.

To make real time statements regarding system status, in the third step, algorithms specifically tailored to the system are developed to diagnose relevant error types and predict the system's remaining useful lifetime. For this purpose, a large pool of various and proven procedures is already available. Finally, the model is implemented and calibrated with historical data. The scientists are convinced that cost-saving potentials can also be realized by the use of condition-based maintenance procedures in other operating-relevant components which have not yet been considered under these aspects.

IN BRIEF

On April 27th, as part of the 2017 Day of Logistics, CML presented solutions for the optimisation of handling facilities for offshore wind energy. Due to the special conditions at sea, efficient transshipment facilities on land and well-developed logistics concepts are required. With their help, construction sites at sea with exceptional requirements can be supplied on time and later, the wind farms successfully maintained.

At the Transport Logistic 2017 in Munich, CML exhibited together with other Fraunhofer institutes and presented a newly developed "Digitalisation Readiness Check" which can be used to help smaller businesses in the development of a digitisation strategy. Additionally, the "MITIGATE" software solution was also presented in live demonstrations, offering companies in the maritime supply chain a comprehensive and on-going risk assessment of their IT systems as well as early detection of threats and vulnerabilities.

+++DATES+++

- **STM Midterm Conference**, 12.-13.9.2017, Region Venice, <http://stmvalidation.eu/>
- **34th International Supply Chain Conference** 25.-27.10.2017, Berlin, <http://www.bvl.de/dlk>
- **Nacht des Wissens**, 4.11.2017, Hamburg, <http://nachtdeswissens.hamburg.de/>

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