

Newsletter 4.25



Dear readers,



in this year's final newsletter, we take a brief look back before looking ahead to the future. The reason: this year, we celebrate the 15th anniversary of Fraunhofer CML.

Looking back on this time, it is clear that we have been successfully addressing the issues of tomorrow for quite some time: the future of maritime innovation is shaped by automation, AI, and sustainability. In this issue, we therefore present NEMO. With this project, we revolutionize command input through dialogue-based voice input for ship operations – fast, safe, and reliable. In the Horizon Europe project CRISTAL, we develop solutions for the precise inspection of inland waterway infrastructure. And the project with the beautiful name KIRMES (meaning fair in German) protects critical maritime facilities through intelligent sensor technology and AI-supported analyses.

From autonomous ships to the digitalization of supply chains – we shape the future of the maritime economy.

I wish you stimulating reading, happy holidays, and a good start to 2026.

Best regards,

Prof. Dr.-Ing. Carlos Jahn

Head of Fraunhofer CML



Three Cells on Wheels (CoW) and the research vessel Vektor in front of Fraunhofer CML in Harburg's inland port.

KIRMES: Mobile sensor networks for maritime infrastructure – intelligently, flexibly, and in real time

Stationary monitoring systems are expensive, inflexible, and often unsuitable for temporary or remote applications. At the same time, threats such as GNSS spoofing, AIS manipulation, and hybrid attacks are on the rise. KIRMES, a project whose German name combines the key terms AI, resilience, maritime, and sensor technology, enables fast and targeted collection of maritime traffic and environmental data using radar, radio, and AIS data thanks to its modular approach, without the expense of permanent infrastructure.

KIRMES offers an innovative solution for protecting critical maritime infrastructure against complex cyber-physical threats. It combines a [mobile sensor network](#), intelligent data fusion, and AI-based analytics to create a comprehensive situational picture, detect threats early, and respond flexibly. The mobile network is ready for use within a few hours and enables adaptive data collection at a wide variety of locations. Its range is between 15 and 30 nautical miles (approximately 28 and 56 kilometer). AI-supported analysis and the integration of proven technologies from Fraunhofer CML make KIRMES a flexible and powerful solution.

The system consists of four components:

- **Mobile sensor network**
Three Cells on Wheels (CoW) and our research vessel Vektor flexibly collect maritime data.

- **Central data platform**
Merges raw data in real time to create a digital situation overview.
- **AI modules**
Proactively analyze data, detect anomalies, and report threats.
- **Cyber-physical situation overview**
Visualizes analyses and forecasts for quick decisions.

KIRMES offers a forward-looking solution for the security and resilience of maritime infrastructure – flexible, intelligent, and efficient.

With the help of innovative technology, security agencies, port operators, offshore wind farm operators, and research institutions, for example, receive precise real-time data that can be used to optimize processes and protect critical infrastructure.

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Talk to me!

Dialog-based command input on board

According to experts, voice input will replace written input of information in many areas of professional and private life in the coming years. A major advantage is the fast and direct communication, in contrast to keyboard input.

Further advantages of voice-based interaction include the reliability of solutions that are mostly stored locally and do not depend on connectivity, as well as the possibility of using the voice as a secure biometric identifier.

The Maritime Informatics team at Fraunhofer CML found sufficient reasons to initiate communication with the ship. Researchers see potential in the developments of recent years: on the path to realizing semi-autonomous systems, the presentation of solutions on the ship's bridge has become increasingly complex. New applications on additional displays, changing data representations, and, last but not least, numerous warnings can obscure crucial options for action, especially in critical situations, due to the flood of information. Voice-based interaction has the potential to bring relevant information to the forefront and communicate it verbally.

The use of language on the bridge to control a ship, but also to request information, is intuitive. NEMO, as the application is called, ensures that commands or requests are understood correctly by repeating them (known as closed-loop communication). Correct speech comprehension is achieved through multi-stage transcription and the use of low-hallucination, classic natural language processing (NLP) methods. This implementation results in a high degree of safety. In addition, NEMO takes into account the available capacities and scope for action for the requested maneuvers, which are determined by the nautical situation, ships in the vicinity, and other factors. This information can also be requested to create

a situation report for the nautical officer. Upon request, NEMO reports, for example, on ships passing at a critical distance or course and adds other relevant information, such as the time until the next approach.

NEMO's performance is being further developed in the [ship simulator environment at Fraunhofer CML](#). The NEMO interface, which displays data important for ship navigation such as course and speed, transcribes commands entered via a microphone in real time. This is achieved by training the software using SMCP, the Standard Maritime Communication Phrases, as well as regular communication on a ship's bridge.

In practice, a dialogue with the navigation system could sound like this:

Nautical Officer: "NEMO, can you help me plan a route to waypoint Alpha?"

NEMO: "I can generate a list of waypoints and display it in the ECDIS."

The aim of developing NEMO is to create a solution that understands all conceivable instructions and questions and implements the respective task under the supervision of the ship's control system based on the information and control systems available on board. NEMO is of interest to ship operators and suppliers, as well as pilot services and training centers.

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Innovative monitoring solutions for safe inland waterway transport in the EU project CRISTAL (symbolic image).

Sustainable preservation of critical transport infrastructure

The maintenance and upgrading of transport infrastructure poses financial challenges for the federal government, states, and local authorities. While research funding often focuses on digitalization, AI, and sensor technology, the materials science basis receives less attention: For port operators, waterway, and shipping authorities, the materials concrete, steel, sand, and gravel are part of their daily business in infrastructure maintenance. Fraunhofer CML is currently involved in several projects that address precisely these issues:

[The Horizon Europe project CRISTAL](#) is developing monitoring and inspection solutions for inland waterway infrastructure and validating them in pilot applications. Use cases include condition assessment of lock chambers and gates, monitoring of sediment banks, and precise measurement of bridge heights. The aim is to provide operators with tools that speed up inspections, reduce effort, and enable maintenance decisions to be made. In the CRISTAL project, Fraunhofer CML is working together with Fraunhofer IML on the work packages Roadmaps, Technologies, and Digital Twin.

[The IHATEC NIMBUS project](#), funded by the Federal Ministry of Transport (BMV), is dedicated to one of the major cost drivers for infrastructure maintenance in seaports and inland ports: the corrosion of steel sheet pile walls. The focus is on smart repair measures, innovative

coatings, including aluminum, and more efficient methods of condition assessment. Test fields are currently being installed in Emden, where coating systems, corrosion, and biological influences will be examined under real conditions over several years. As part of the NIMBUS project, the project consortium has conducted a comprehensive inventory of organisms on sheet pile walls, not least to better understand their influence on rusting and the preservation of the sheet pile walls.

The EU Commission is going one step further. Its climate policy aims to drastically reduce emissions from transport infrastructure (construction, operation, decommissioning) and increase resilience to climate change and extreme weather, while minimizing negative impacts on the environment and biodiversity.

The CRISTAL and NIMBUS research projects are particularly interesting for public administration, which is responsible for approving and monitoring construction projects and thus also for building and environmental regulations.

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New brochure marking the 15th anniversary of Fraunhofer CML

This year, Fraunhofer CML celebrates 15 years of application-oriented research in the maritime sector! From the very beginning, our work has focused on technological innovations for a more efficient, safer, and more sustainable maritime economy: solutions for autonomous and remote-controlled ships, AI-supported processes for optimizing port operations, and the digitalization of maritime supply chains. Other research priorities include sustainable transport processes supported by data analytics and quantum computing. Our focus for the future: automation, resilience of global supply chains, and ecological challenges to strengthen the maritime industry technologically and sustainably.

The anniversary brochure with the motto "15 Years – Innovating the Maritime Sector" can be found below, as well as our new video for download.



Save the Date: Maritime Innovation Insights (MII) on May 7, 2026!

Next year, we will once again welcome numerous participants to our annual lecture event, which presents new solutions for shipping, ports, and the maritime industry of the future. In addition to exciting insights from users and researchers, our guests will have time for professional conversations and visits to demonstrations in our laboratories.

Take advantage of this opportunity to learn about the current state of autonomous processes in navigation, mobile robotics at the terminal, and optimized operating processes in the maritime transport chain. We look forward to seeing you there!

Further information about the program for 2026 and registration will be available shortly on our website.



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