

e\MIR eMaritime Integrated
Reference Platform

eMIR eMaritime Integrated Reference Platform

- eMIR is an open initiative of the German maritime industry for improving safety and efficiency in maritime transportation systems.
- eMIR provides a framework for engineering, validation, verification, and demonstration of technological innovations as for new cooperation and process models.
- eMIR supports user integration into the design process.
- eMIR provides practical and empirical foundation for the development of international regulations and standards.
- eMIR fosters a sustainable market position for vendors of maritime safety systems and components.

Providing a generic, open communication and service platform, eMIR connects industry strengths in surveillance and control technology to a smart demonstration platform. Furthermore, it allows research for better understanding of maritime systems and offers a powerful virtual and physical testbed for system/component development, verification and validation. Polymorphic, adoptable interfaces guarantee a fast configuration of demonstration environments and testbeds. eMIR combines the following demonstrators and services.

LABSKAUS

An integrated set of services for verification and validation of e-navigation technologies, e. g.: a reference waterway from the mouth of the river Elbe to the Port of Hamburg, an experimental VTS-System, a mobile bridge system, mobile container-based bridge and surveillance platforms.

www.emaritime.de/services/labskaus

HAGGIS

A virtual testbed based on maritime traffic simulation, sensor simulators, environment simulators, a cognitive human behavior simulator.

www.emaritime.de/services/haggis

This initiative is driven by the German working group Maritime Safety for the National Masterplan Maritime Technologies (NMMT) as a platform for a national industry demonstrator.

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Modeling

- Model building with real data
- Identify ship dynamics parameters
- Environment monitoring
- Model evaluation with real data
- Evaluation of new sensor processing technologies
- Model use-cases
- Critical traffic situation detection
- Higher efficiency of sea traffic

Engineering

- Tests with real applications
- Model in the loop
- Hardware in the loop
- System in the loop
- Assets for industries
- Reference data / API
- Testbed as a service
- Design process with industry standards

Demonstration and Validation

- Demonstrating, visualization, validation and evaluation of new products/technology
- Standard scenarios for validation
- Metrics: rare errors, risk, performance, capacity, cooperation and human performance

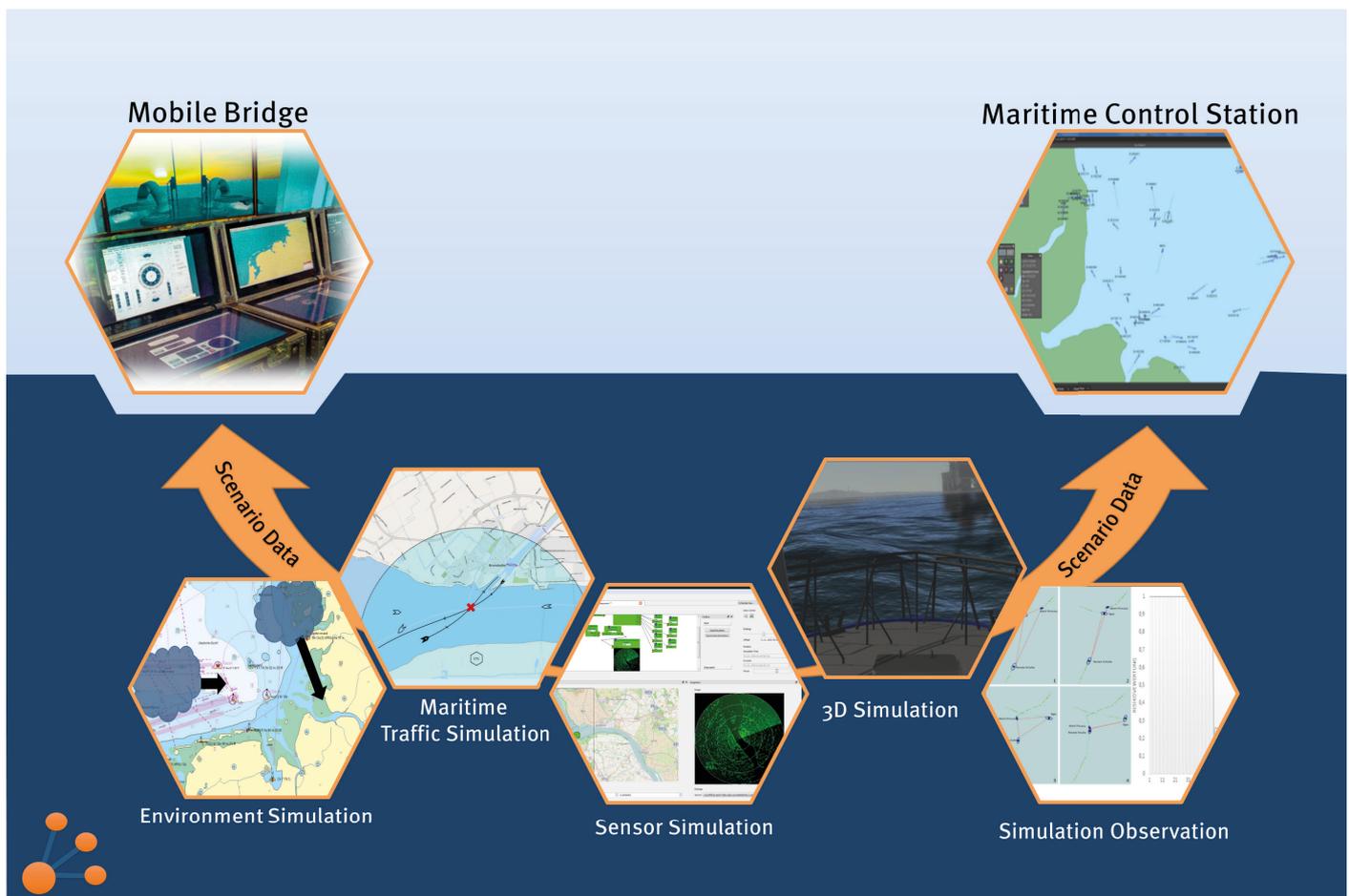
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HAGGIS - Virtual Test Environment

HAGGIS is an open modelling and co-simulation environment, within the eMaritime Integrated Reference Platform. Its purpose is rapid testing of new eMaritime technologies. Due to the character of maritime transportation, HAGGIS consists of a number of simulation modules, like a sensor simulation including error models, a simulation to provide environmental impacts or the simulation of maritime traffic flows, which can be orchestrated for different applications. These modules are set up as a large scale simulation environment at OFFIS in Oldenburg and the Federal Maritime and Hydrographic Agency in Hamburg.

Capabilities of the Maritime Testbed

It defines suitable co-simulation interoperability concepts to use heterogeneous maritime simulations for early testing of new assistance systems, like route and traffic data exchange between ship and shore, to validate those system prior to physical test runs.



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Maritime Traffic Simulation (MTS)

The MTS is a flexible maritime traffic simulator for implementing, executing and observing the behavior of multiple vessels in a simulated environment. Besides simulation of a large number of vessels with multiple ship dynamics and behavior models, the MTS can be coupled with a sensor simulation to generate realistic sensor measurements from a simulated context. In addition an environment editor and simulator can be connected to the MTS to describe and simulate different maritime environmental factors like wind, current or tide.

The maritime traffic simulation can be used for:

- Simulation of complex traffic situations, e.g. for traffic management, optimization and observation tasks.
- Simulation of specific encounter situations, e.g. near collisions of vessels for assistance system validation under various environmental conditions.

Simulation of maritime traffic scenarios either can be performed in real time, for example in combination with a 3D Simulation or in accelera-

ted time, for simulation based risk assessment using the Risk Monitor.

3D Simulation

HAGGIS comes with a 3D environment simulation. This 3D simulation consists of a 6 DOF dynamic model that directly interact with generated waves, current and wind. The MTS is used to generate other traffic participants, which interacts with the own ship, including collision detection. Together with LABSKAUS's mobile bridge solution the 3D Simulation is used for:

- Demonstration of simulated scenarios
 - Situational Awareness studies
- In both cases the MTS generates monitoring data (e.g. AIS, NMEA, ...) to be feed into experimental or commercial navigation solutions.

Scenario Editors

HAGGIS comes with editors, to configure and control simulation scenarios in an easy and intuitive way:

- EMod is an editor that provides a system model to allow setting up a static scene according to a predefined scenario. This system model contains the fundamental components / entities of all used resources, actors and environmental factors. The user is able to load 3D geometric models of e.g. ships. The properties of these objects can be set according to the user's need.
- MOPhisTo is a graphical editor for the modeling of normative maritime work processes, including the individual behavior of different actors in relation to the environment and its dynamics. Normative processes can be defined with a graphical notation as the basis for model-based safety analysis and optimization. The models can be executed, changes of agent states are communicated via HLA to their related objects in the simulation environment.

Co-Simulation Ecosystem

To archive interoperability with other simulation environments, HAGGIS supports different simulation and interoperability standards:

- S-100 based data model: The world data model is the common semantic basis for all simulations and new developed e-navigation technologies. It is based on IHO S-100 and is the virtual representation of the physical world. All simulation components as well as components of the physical testbed use this data model to generate high value semantically enriched information.
- HLA: The widely-used IEEE 1516e standard is used for distributed co – simulations within HAGGIS and allows external simulators (Federates) to interact with HAGGIS simulations.
- Simulation Management: The DistriCT tool is used to automate simulation experiments and analysis. Simulations can be distributed to different physical platforms. During an additional step the simulation components can be automatically configured to perform a systematic parameter space exploration.

Simulation Observation

The risk monitor is used to determine the distance to predefined risk situations during simulation runs. To determine the risk proximity distance functions are used. In order to create them a methodology exists, which supports the selection of influent attribute values of the system description and their combination using fault trees. The Risk Monitor allows the calculation of distances for different risk situation at any given time of a simulation run.

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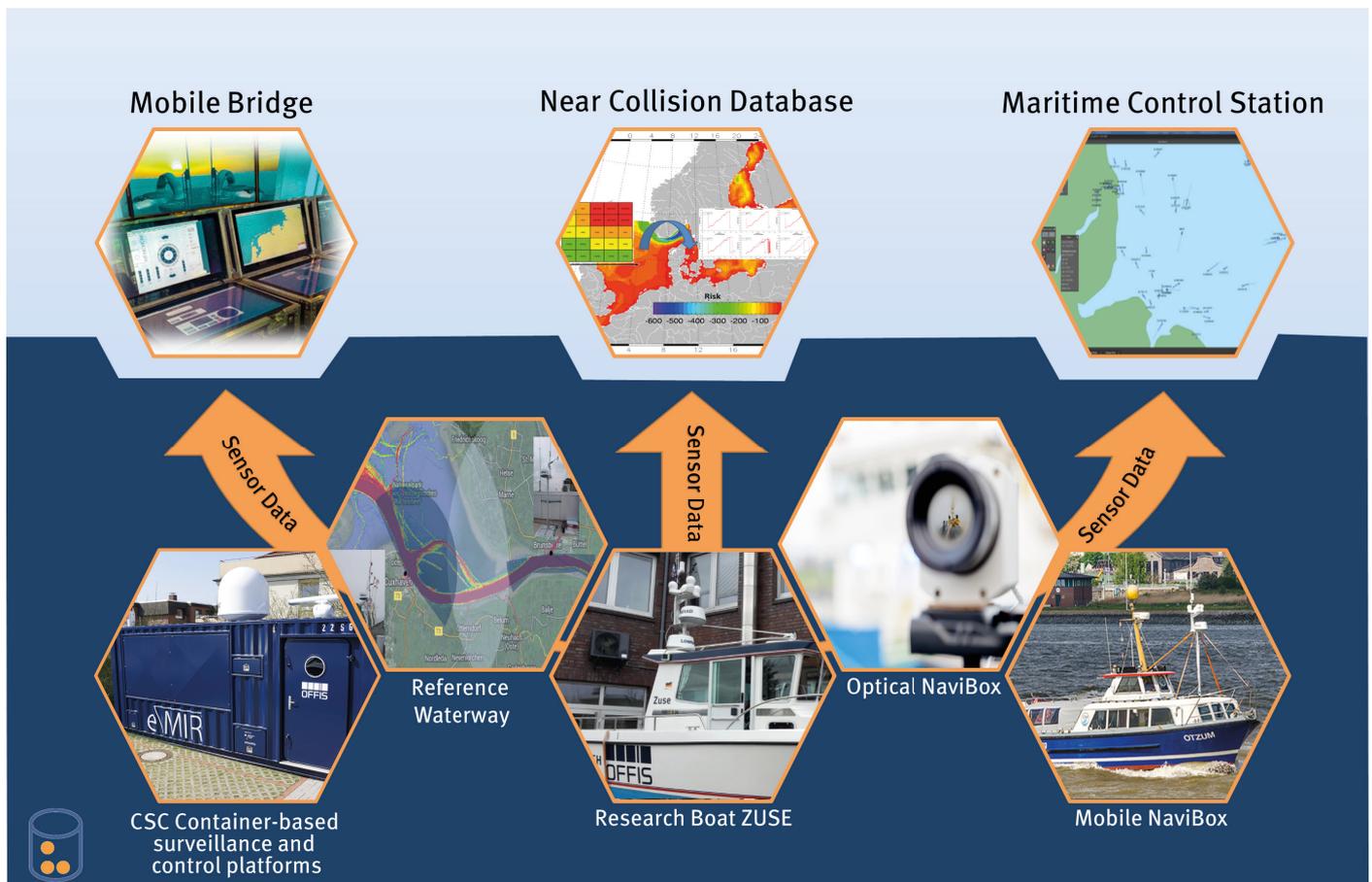
LABSKAUS - Physical Test Environment

LABSKAUS is a physical platform for research in better understanding of maritime transportation systems and e-Navigation, a test bed for design, development and testing of new surveillance and assistance systems and a demonstration environment to present the power and capabilities of new products and services. It provides services accessible by eMIR polymorphic interface concepts.

Capabilities of the Maritime Testbed

Maritime testbed for empirical study of maritime transportation systems, supporting engineering of new high autonomous systems and validation and demonstration of existing systems. It consists of the following components:

- research boat Zuse equipped with sensors and automation capabilities for remote and autonomous sailing
- mobile CSC container-based platforms for maritime surveillance and control from shore and from ship
- broadband communication platform covering the whole German Bight
- sensor technologies for high resolution wide area surveillance
- Hardware simulation platforms for simulation of embedded systems



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LABSKAUS

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Reference Waterway

The Reference Waterway covers the Elbe and Kiel Canal Approach near Brunsbüttel, Germany. It covers a basic maritime surveillance infrastructure with three NaviBox Stations (including AIS, Radar, cameras) and broad band communication via LTE. The Reference Waterway is used as a experimental platform and for demonstration of new technologies as well for setting up a database with travel pattern and near collisions. The Reference Waterway offers the following services:

- AIS Service (AIS): allows receiving of messages of the Automatic Identification System from traffic objects and transmission of messages
- Environmental Sensor Service (ENS): provides measurements of relevant parameters of the maritime environment
- Radar Service (RAD): provides all radar-derived data, i.e. radar images, radar plots, and radar tracks, each of which with radar-specific relevant quality parameters
- Video Service (VID): provides visual observation of waterways covered by video cameras

Mobile Bridge

For bridge experiments in lab and on ship a Mobile Bridge system allows set up of an experimental bridge on board without interfering with the vessels navigation systems. It provides

a Integrated Navigation System and is linked to a NaviBox which provides required navigational data such as compass, GPS, AIS, log, lot, radar, as well as a broad band of communication systems. The mobile bridge provides services for experiments of assistance systems, human machine interfaces, new instruments and new communication and coordination technologies.

The overall mobile bridge system is transportable within three boxes including flexible configurable double touch-screen components, and ready-to-use for experimental applications with or without external power supply. Besides type approved solutions from various manufactures, LABSKAUS solutions can be used or customized according to specific user requirements:

- A controlling unit enables ship steering e.g. put the rudder
- The EPD-Ship (e-Navigation Prototype Displays) is acting as an ECDIS like ship side application
- A radar display as common on ship bridge systems.
- The NAVTOR NavStation, a software that integrates all digital navigational data for optimal on screen presentation to plan and organize a safe, secure and economical voyage.
- The NAVTOR G-ECDIS, designed for assisting mariners in performing all essential navigation tasks including route planning and monitoring, keeping chart data up to date, and providing safety of navigation.
- The Chartworld eGlobe G2, next generation of ECDIS software, assistance of experienced nautical officers, focusing on the practical usage for modern seafaring

Maritime Control Station

The Maritime Control Station is the shore side VTS (Vessel Traffic Service) monitoring system as used by harbors or port authorities for visualization of

operational pictures. It can be linked to the Reference Waterway as well as to the virtual environment HAGGIS. Multi-touch displays are used for HMI research applications to improve the current state-of-the-art designs. Besides type approved solution from various manufacture and LABSKAUS solutions can be used or customized according to specific user requirements:

- The EPD-Shore (e-Navigation Prototype Displays) is acting as a VTS system like shore side application
- An experimental VTS system was implemented by Signalis
- The NAVTOR NavStation, a software that integrates all digital navigational data for optimal on screen presentation to plan and organize a safe, secure and economical voyage.

NaviBox

The NaviBox is a mobile, connectable sensor data hub with supports navigational data on board as well data for maritime surveillance systems. Sensors can be configured ad libitum. The NaviBox supports WLAN and Broad Band WAN communication facilities, and supports LABSKAUS with following sensors (Transport & Protocol handlers):

- AIS Receiver (CAN, NMEA 2000)
- RADAR (TCP/IP, T9174 protocol)
- Wind-Sensor (CAN, NMEA 2000)
- D-GPS (Compass, GPS)

Research Boat Zuse

The high performance and seaworthiness Research Boat Zuse enables testing of new e-Navigation solutions under real-world conditions. Equipped with the NaviBox it provides life sensor data like AIS, radar, D-GPS, compass.

Communication Infrastructure

The technological backbone of LABSKAUS is a message passing systems that provides S-100-compatible data exchange.