SMART*FRAME*
Innovative Nautical Solutions: A Modular Testbed Framework

Innovative nautical solutions

In recent times where the maritime world adapts new strategies to modernize shipping such as Shipping 4.0, cyber-shipping and e-Navigation, novel innovative nautical solutions are essential for all maritime sectors in industry and research. The International Maritime Organization defined that e-Navigation requires harmonized collection, integration, exchange, presentation and analysis of marine information on board and ashore. However, a proper development and test environment is necessary, before innovations can be rolled out on the fleet.

Target group

On board solutions are important for device manufacturers, ship managers and mariners. Stakeholders for ashore systems are ship managers, port administrations and IT service providers. Innovative software solutions can act as autonomous controller, provide navigational support, simplify shore based maintenance and observation, optimize voyage planning and hence reduce overall operational costs for all stakeholders.

Key issues

The development of innovative nautical solutions faces various key issues:

- Development requires simulating real-time scenarios that reflect the sensory and environmental circumstances of a real vessel while in operation.
- One solution often comprises a cluster of interdependent applications that need to exchange data in real-time, be platform-independent and be remotely accessible.
- The effort to attach novel solutions and continuously upgrade existing systems needs to be minimal.

Our solution

Fraunhofer CML's SMART*FRAME* resolves the above mentioned issues by means of:

- ship handling simulators to produce realistic test environments,
- a centralized data communication unit to enable fast data exchange and remote access, and
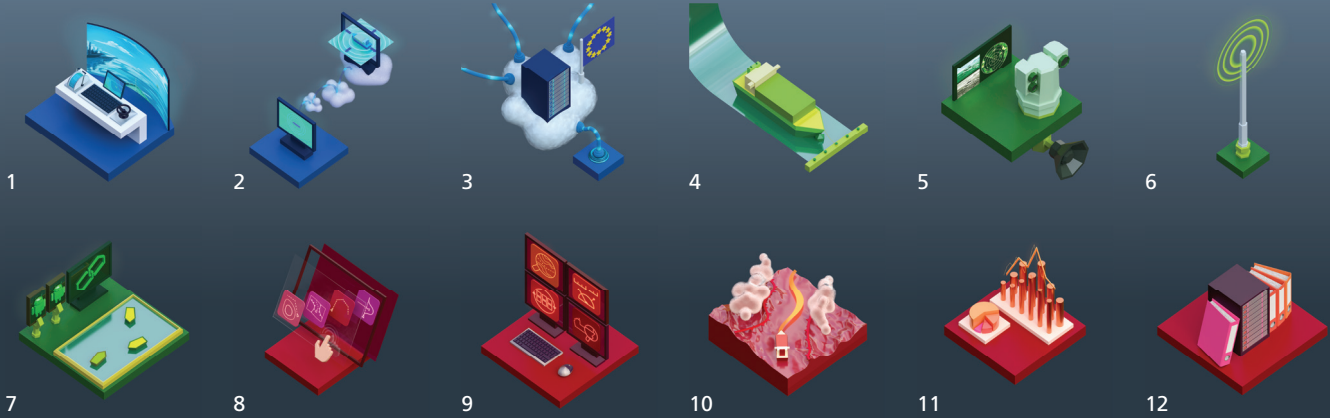- a modular testbed structure to quickly attach and upgrade applications.

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Autonomous navigation testbed

Fraunhofer CML adapted SMART*FRAME* for the development of an autonomous navigation testbed as shown on the front page. It comprises of modules for simulators (blue), applications (red) and real devices (green). All modules communicate with each other through a centralised data server in the cloud.

Simulators

Simulators act as data sources and sinks for development and validation of nautical solutions by producing realistic maritime scenarios. The centralised, standardised design enables simple integration of your simulator to the existing testbed. Already integrated simulators are e.g.:

1. Ship handling simulator

Commercial ship handling simulators integrated to the testbed act as a source for ship's position, AIS and radar information and respond to navigational commands from external modules.

2. Virtual ship handling simulator

Virtual ship handling simulator software allows generating multiple scenarios which accelerate parallel software development.

3. European simulator network

The attached European Simulator Network allows creation of large scale test campaigns involving qualified nautical personnel for investigation of digitalization of ship-ship interaction issues.

Real devices

Standardised communication formats allow integrating real devices. SMART*FRAME* supports embedding your maritime device for further development, validation or presentation. Already integrated devices are e.g.:

4. Vessel

Sensory equipment from a vessel feed data (such as position, AIS, Radar etc.) into on-board (e.g. for autonomous navigation) or remote cloud server (e.g. for monitoring from shore).

5. Advanced sensor module

The Advanced Sensor Module takes care of look-out duties on board the vessel by continuously fusing ship sensor data with modern daylight and infrared cameras.

6. AIS antenna

AIS antennas stream live data into the cloud to be used by testbed modules for analytics and to act as an additional AIS data provider for navigational systems.

7. Model ship testbed

A local model ship testbed wirelessly connected to the cloud server enables autonomous navigation of downscaled ship models for validation and presentation purposes of developed nautical solutions.

Applications

Interdependent software applications processing ship sensory data to achieve specific functionalities are integrated to form customized nautical solutions. The modular testbed framework allows integration of your existing or planned nautical software solution. Already integrated applications are e.g.:

8. Autonomous ship controller

The autonomous ship controller enables automatic navigation of a ship. It consists of submodules such as a track pilot to follow a predefined voyage plan, a weather controller for route optimization and a collision avoidance controller that complies with the international regulations for preventing collisions at sea (COLREGS).

9. Shore control centre

The shore control centre continuously monitors the autonomously operated ship (or fleet of ships) and enables control intervention by a shore-based human operator, if necessary.

10. Electronic nautical chart app

The Electronic nautical chart app continuously displays the traffic situations around the ship. It acts as the user interface for operational settings, observation and manual control in the autonomous ship controller and shore control centre.

11. Analysis application

The analysis application comprises of algorithms to analyse maritime traffic situations and testbed performance.

12. Data archive

The data archive stores all relevant data traffic of the testbed operation for future reproduction and ex-post analysis.

Our service

SMART*FRAME* was originally formulated for the development of autonomous nautical software applications in a simulated environment. However it is highly adaptable and can be tailored to specific user needs. Data sources can be simulators or real device, and data users can be software application or technical instruments. We offer:

- customizing a modular testbed with centralized data exchange unit to fulfil your specific user requirements,
- conceptualizing and developing your innovative software solution,
- integrating your simulator, application or device into our existing testbed, and
- assessing and validating your application or device in a simulated realistic environment.

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