Prof. Dr.-Ing. Nick Rüssmeier, Department of Engineering
Mechatronics with focus on optical sensors and systems

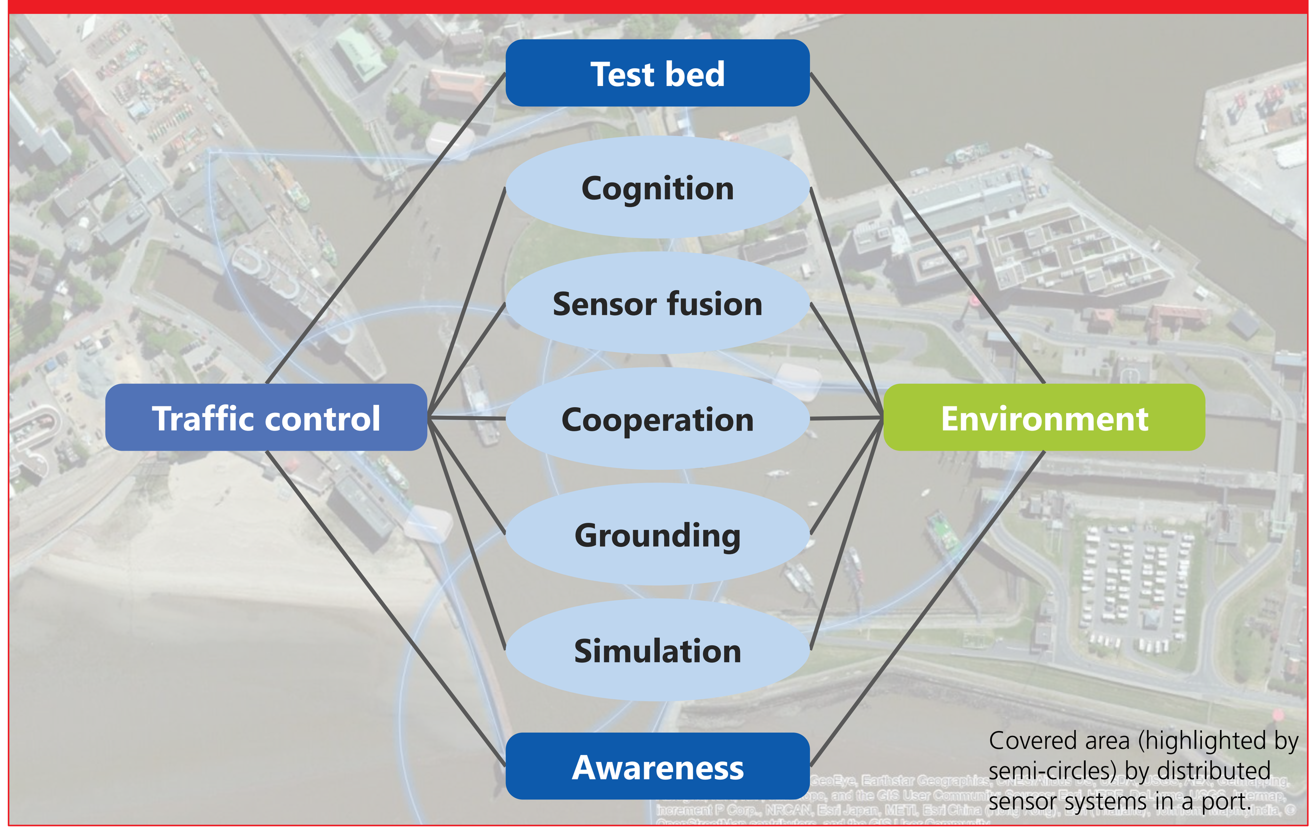
Sensor Systems - Data Stream Architecture
-Datafusion of Distributed Optical Sensors-

OBJECTIVES

Real study sites utilized as a physical experimental test bed for sensor data fusion, communication technology and data stream analysis tools can provide substantial frameworks for initial design and development of new systems, applications and services. The research and development of sensors and sensor-systems adapted with new technologies meets the forward-thinking need to improve time-to-market, or standardize new industrial products and technologies.

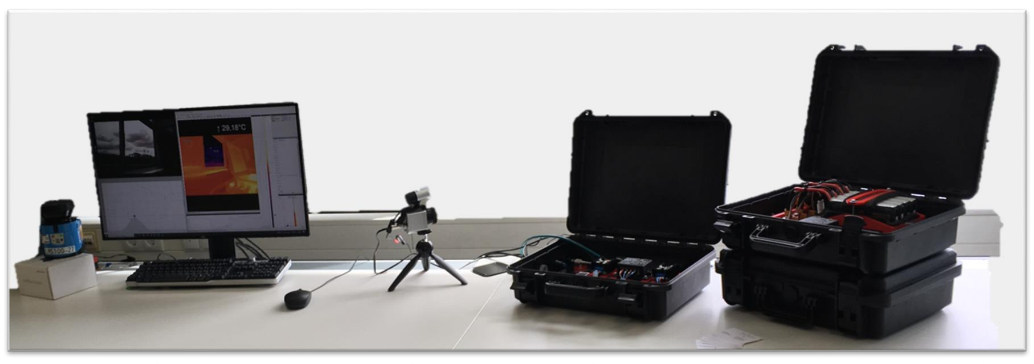
The objective here was to develop and implement a modular expandable sensor data fusion architecture in form of a data stream management system. Data from the environment shall be collected, analyzed and new services established in different applications in the real-world setting. Methods and tools to observe, monitor and communicate in the environment that can be applied to distributed optical sensor systems (LIDAR, visual and infrared cameras) shall provide a situational and environmental assessment.

APPLICATIONS



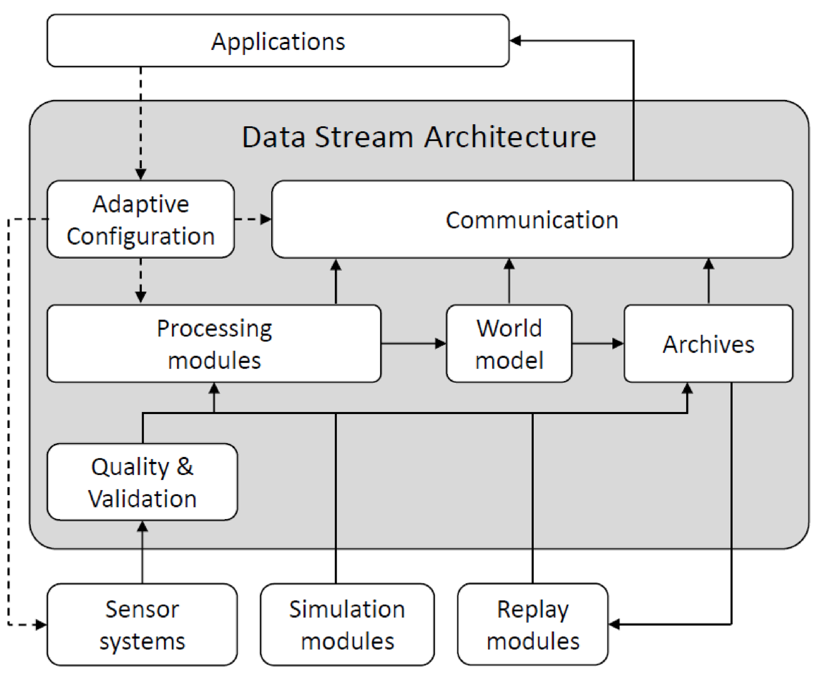
Covered area (highlighted by semi-circles) by distributed sensor systems in a port.

SYSTEM ARCHITECTURE OF DISTRIBUTED OPTICAL SENSOR SYSTEMS & EXPERIMENT TESTBED

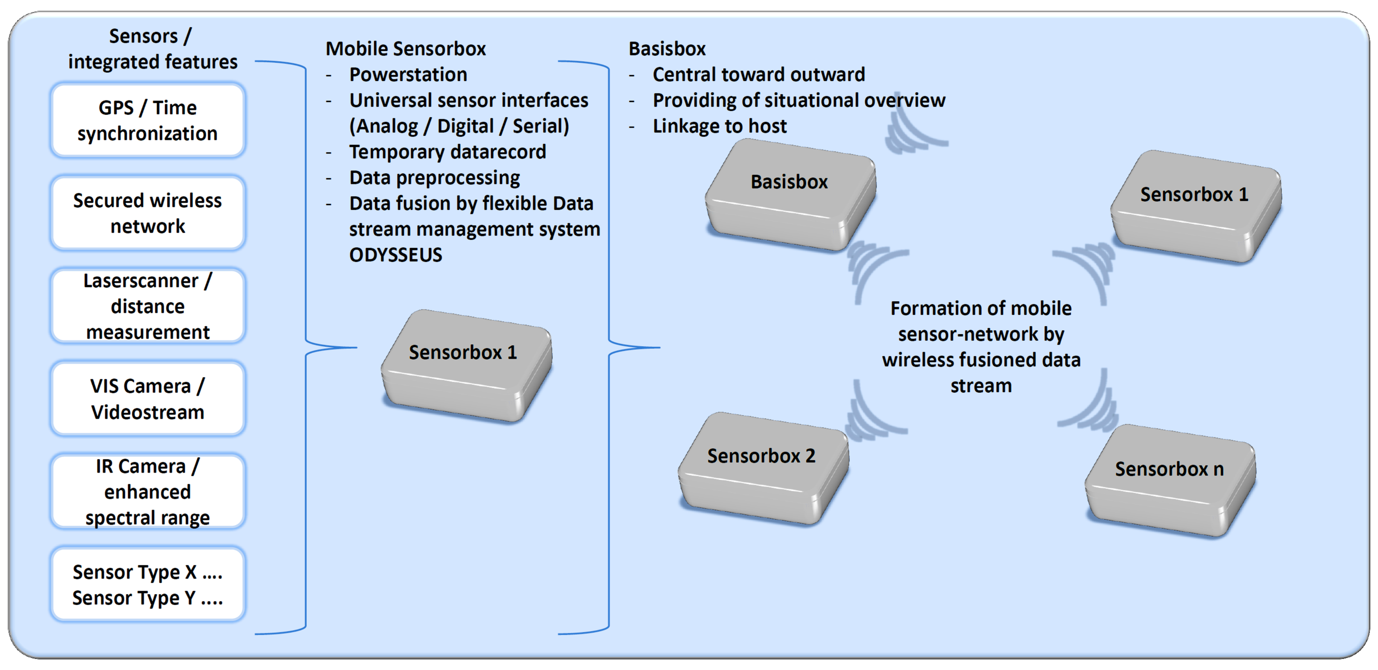


Physical components of the optical sensor systems test bed system (mobile, self-sufficient, modular and expandable)

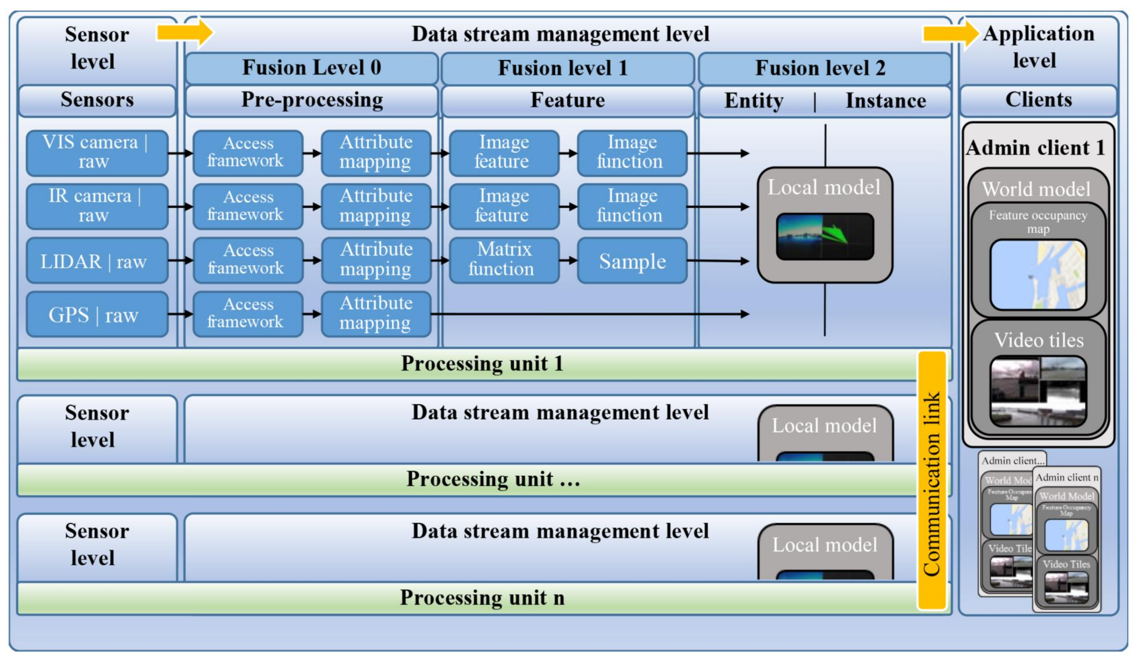
- Modular data stream architecture for sensing, simulation and replay
- Data stream management system for data fusion, georeferencing and dashboard user interface
- Mobile self-sufficient flexible optical sensor systems with harmonized setup
- Wide coverage of observation areas by distributed sensor systems in the environment
- Wireless network based sharing of data streams for participants
- In-situ experiments using stationary and mobile sensor systems



Components of the test bed system data stream architecture, from sensor to applications



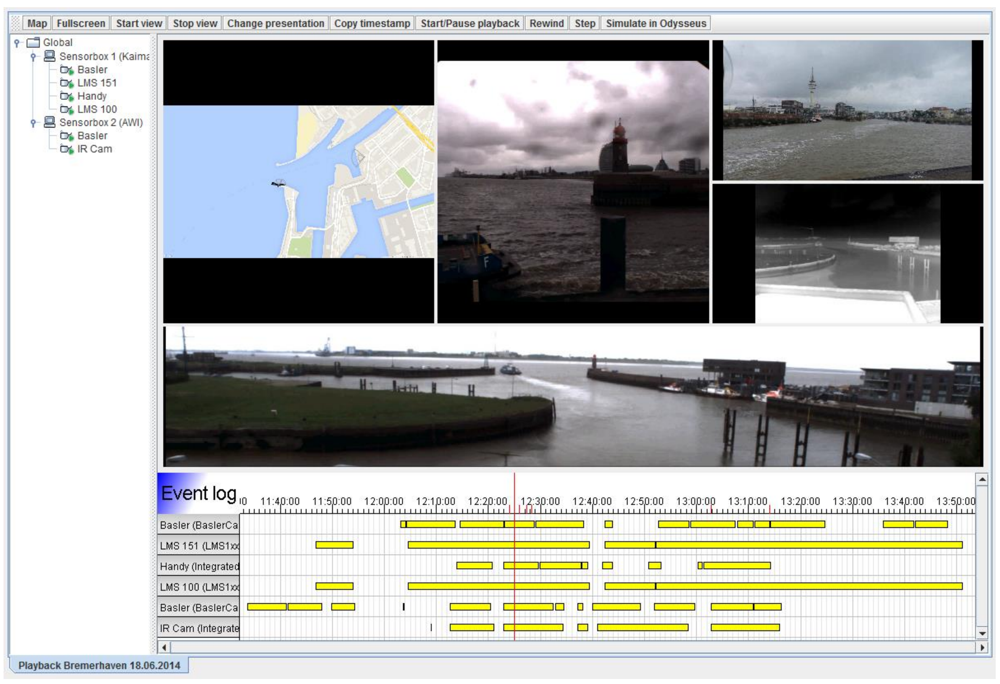
Structure of a single mobile sensor system with sensors and integrated features and schematic of a multi-hop Wi-Fi network formed by distributed sensor systems



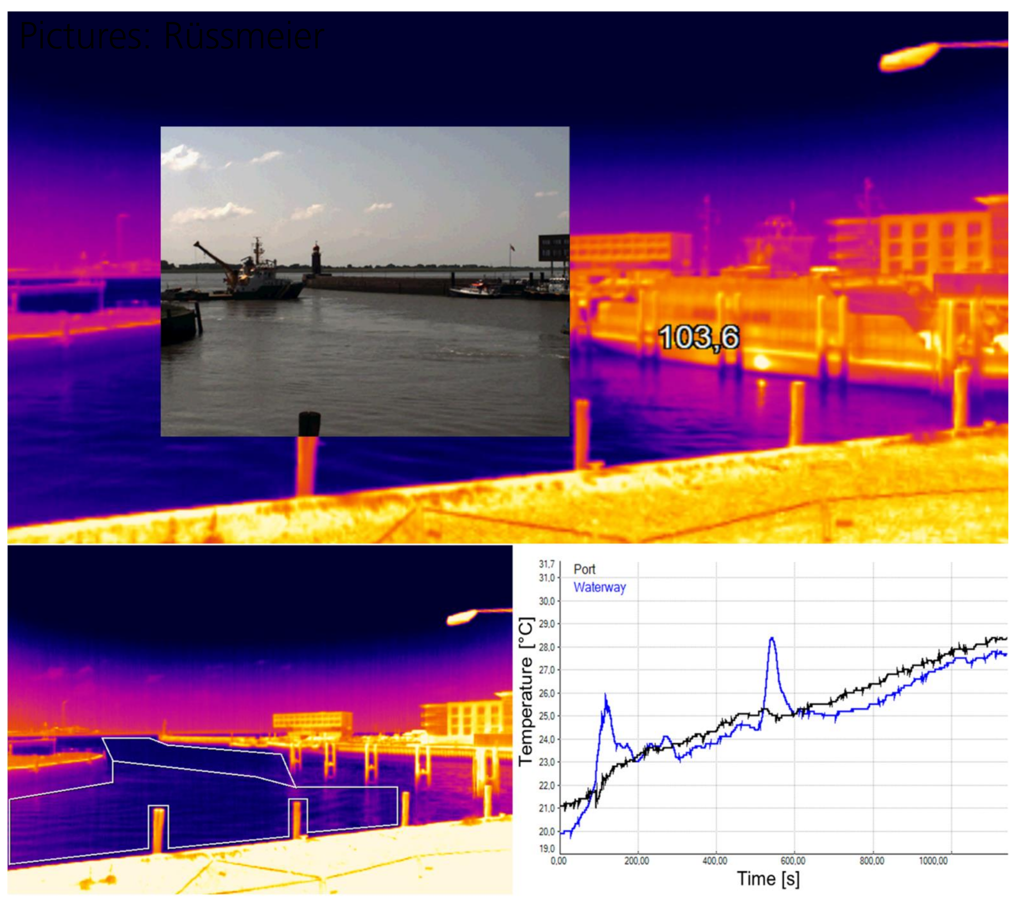
Data stream fusion level, steps to integrate distributed and inhomogeneous sensors and systems to one “world model”

SITUATIONAL AWARENESS

- Remote **sensing** by **optical sensors** – cameras visual / infrared and LIDAR
- Mutual **sharing** and **assessment** of the **situational** and **environmental** live picture
- **Online** detection of relevant **situations**
- **Object** and **person recognition** (in water)



Interface of the data stream management system with covered scenes from the physical experimental test bed



Event processing determination of temperature signatures in the port area and corresponding time series by IR-Camera.

CONCLUSIONS

- General-purpose structure for processing interfaces
- **Ad-hoc sharing** of sensor data
- Multi-hop Wi-Fi network
- **Detection** of relevant **situations**
- **Providing** a physical experimental **test bed**
- **Maintainability**, **flexibility** and **extensibility** for new sensors, actuators and software components.

FURTHER APPLICATION OPTIONS

- Gather data and meta-information for further analysis and reuse recorded quality annotated data to enable further application studies
- Simulation and physical based testing of traffic assist systems, docking and berthing assistance at harbors
- Ocean current observations by infrared and visual Large Scale Particle Image Velocimetry (LSPIV)

REFERENCES & ACKNOWLEDGEMENTS

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