



# SmartKai

An assistant system to prevent damage  
to ships and port infrastructure

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- **Introduction**
- **Motivation/Problem Statement**
- **Solution Approach**
- **Project State**
  - Test field
  - Current Challenges
- **Outlook**

- **OFFIS**

- Institute for Information Technology in Oldenburg, Germany

- **eMIR (eMaritime Integrated Reference Platform)**

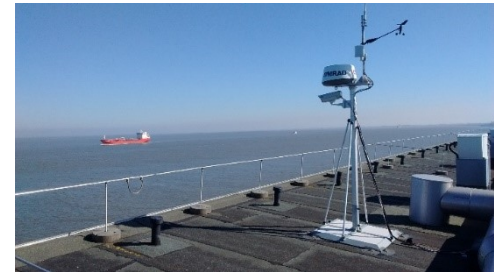
- Verification and Validation of maritime systems
    - Using Scenario-based Testing
    - Providing a test area for autonomous system testing
  - Testbed in Germany
    - German Bight, test fields in multiple harbors
    - Traffic Monitoring since 2016

- **SmartKai**

- Development of a ship-independent assistance system installed in the port



eMIR



- **High traffic volumes on waterways and in ports lead to more frequent hazardous situations**
  - Ships maneuver in areas that are difficult to see or assess
  - Complete ship rotations in narrow port basins
  - Pilots must adapt to constantly and sometimes rapidly changing environmental conditions
  - Economic pressure and tight time frames
- **This results in more frequent cases of damage**
  - Many minor damages are not immediately detected
  - Consequences:
    - Economic damage
    - Lengthy legal proceedings
    - High administrative effort
    - Impairment of port operations

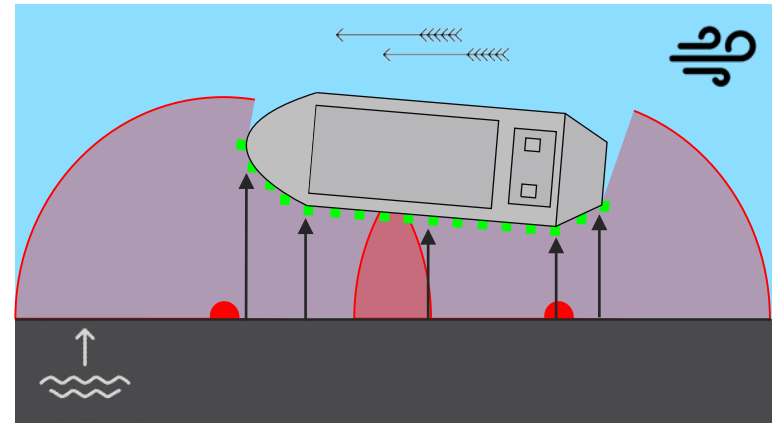


## ▪ SmartKai – Port Assistance System

- Development of a port- and sensor-based assistance system
- Integration of environmental data to support decision making during difficult maneuvers
  - Tide, current, wind
- Target group-related – visual – representation of all parameters
  - Distance and speed estimation to quay walls and jetties
- Traceability
  - Recording of possible dangerous situations
  - Assignment to AIS signals or camera images



© SICK



- **NPorts**
  - Provision of the port infrastructure
- **SICK**
  - Development of a new LiDAR sensor
    - Specialized for maritime environments
    - Higher distance
  - Provision of inventory sensors
- **HuMaTects**
  - Development of the UI for pilots / port captains
    - PPU, Tablet, VR-Glasses
- **OFFIS**
  - Test field development
    - Integration of sensor technology
  - Development of a data processing pipeline
  - Contributions by simulation

Niedersachsen  
Ports

**SICK**  
Sensor Intelligence.

**HUMATECTS**  
THE HUMAN-MACHINE ARCHITECTS



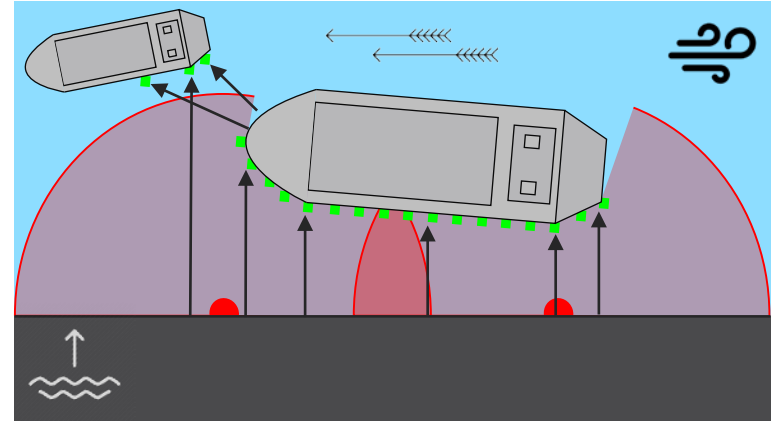
OFFIS

### ▪ Pilot survey (functional requirements)

- Distance calculation (max  $\geq 100\text{m}$ )
  - to quay, bow and stern, other ships
- Speed of Approach
- Environmental Data
  - wind, tide, current

### ▪ IMO (non-functional requirements)

- Derived from GPS requirements for (automated) docking purposes (Resolution A.915(22))
- Accuracy  $\leq 0.1\text{m}$
- Availability (% per 30 days)  $\geq 99.8\%$
- Fix Time Interval  $\leq 1\text{s}$



## ▪ Questions

- How can port-side assistant systems be tested?
- Which test cases need to be executed?

## ▪ Requirements derivation



## ▪ Example:

- Distance between two ships → multi ship detection → multiple scanners



# Project State

## Prototype

### Prototype implementation

- Located in Wilhelmshaven
- Setup is designed according to the structure of RORO bridges
- Berth location with reduced complexity
  - Located in enclosed area
  - No current and tide changes
- Sensors
  - 2D LiDAR sensors, AIS, Wind, Camera



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### Ships

- Research boat „Josephine“ (OFFIS)
- Port operation ship „Argus“ (NPorts)

### Scenarios

- Considered Use Cases :
  - Docking, Multi-Ship Encounters
- Scenarios are performed multiple times with different parameters
  - Speed, attack angle, distance to quay, maneuvers

### Evaluation measurements

- Position measured via DGPS
- Camera images



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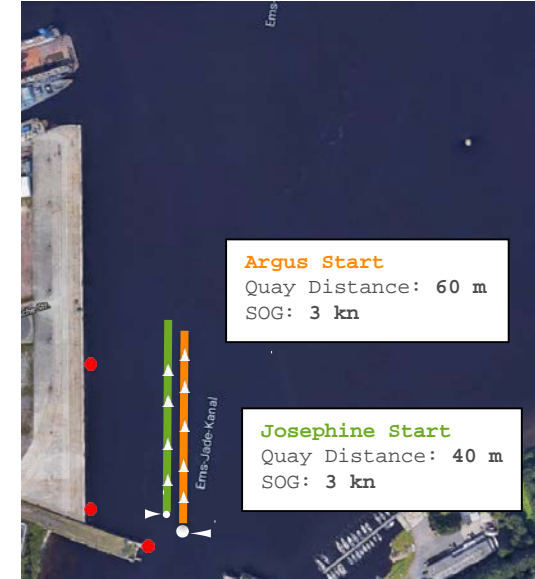
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## Cover Maneuver

- Performed with Argus and Josephine
- Josephine is covering Argus
  - LiDARs are not able to detect the complete hull of both ships

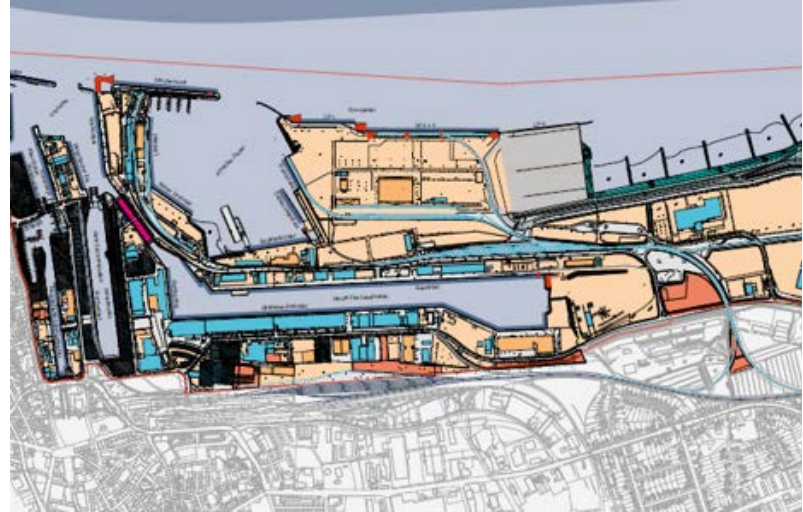


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- **Test field still operating during winter**
  - Testing during cold temperatures
- **SmartKai is moving to a new location in Cuxhaven**
  - Using 3D LiDAR sensors
  - Challenging current and tide changes
- **Assistance system development**
  - Development of a processing pipeline
  - Verification and Validation of SmartKai
    - Using scenario-based testing and test campaigns



## ▪ **SmartKai – Port Assistance System**

- Development of a port- and sensor-based assistance system
  - To prevent damage on ships and harbor infrastructure
  - To support pilot during docking
  - Integration of environmental data to support decision making during difficult maneuvers
- Verification and Validation using scenario-based testing
  - Using the eMaritime Integrated Reference Platform



Questions?  
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KAI