SmartKai

An assistant system to prevent damage to ships and port infrastructure

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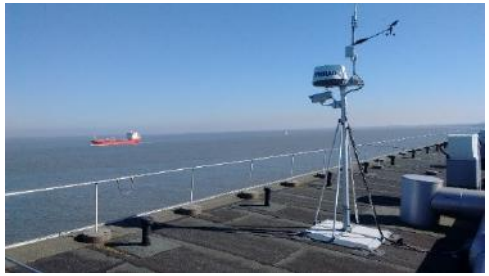
Introduction

- **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

Motivation

- **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

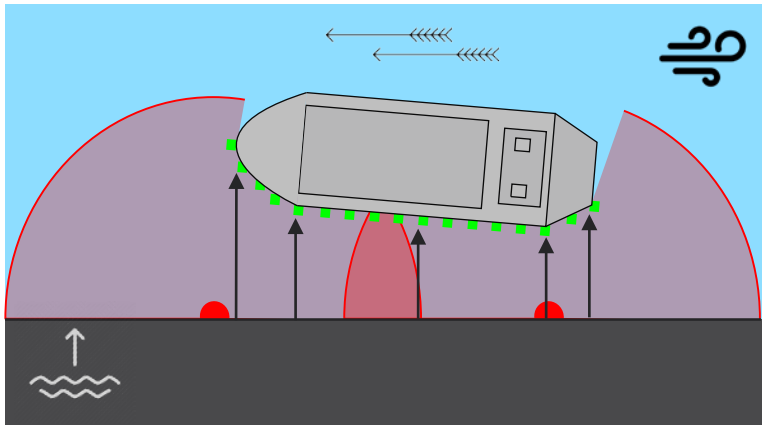
© DPA

© THB

Solution Approach

- **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



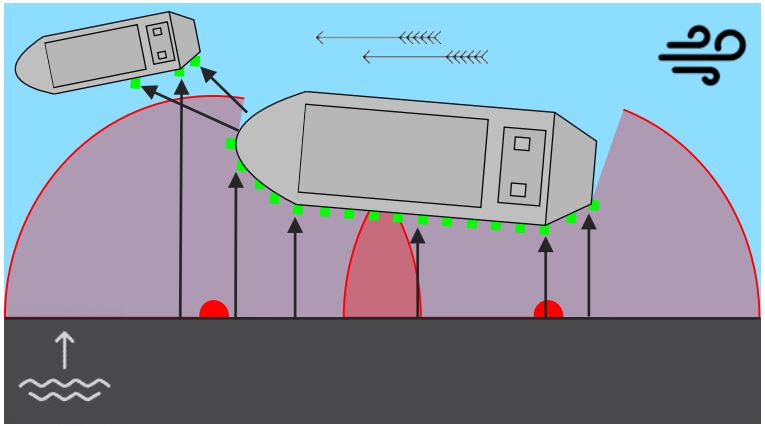
Partners

- **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

Project State

Requirements

- **Pilot survey (functional requirements)**
  - Distance calculation (max >= 100m)
    - 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 <= 0.1m
  - Availability (% per 30 days) >= 99.8%
  - Fix Time Interval <= 1s

Project State

Test campaign

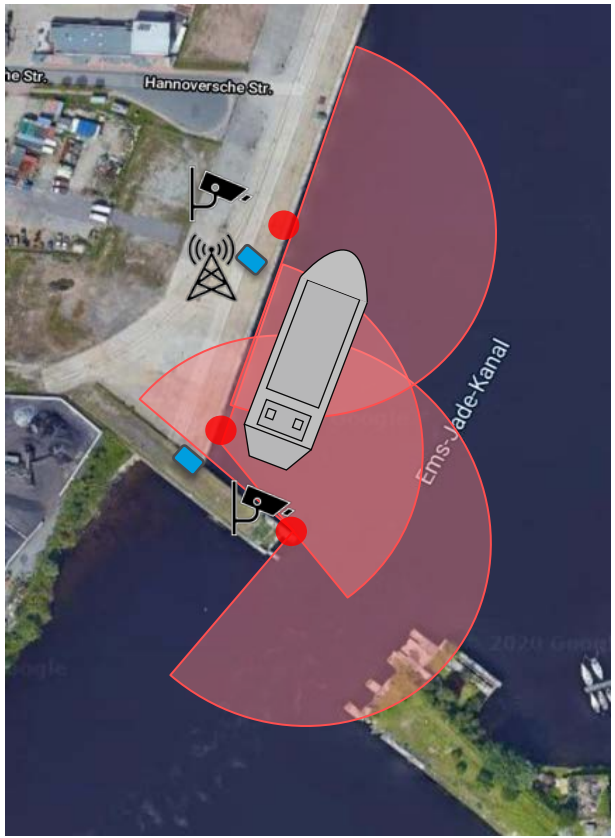
- **Questions**
  - How can port-side assistant systems be tested?
  - Which test cases need to be executed?
- **Requirements derivation**

- **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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Project State

Test campaign

- **Ships**
  - Research boot „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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Project State

Scenario Example

- **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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Outlook

- **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

Summary

- **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?