AUTONOMOUS TECHNOLOGIES FOR UNMANNED CARGO SHIPS

Dipl.-Wirtsch.-Ing. Univ. Hans-Christoph Burmeister

18.03.2015 – Digital Ship, Hamburg
AGENDA

1. Fraunhofer CML introduction
2. MUNIN overview
3. Autonomous Bridge
4. MUNIN Test-bed
5. Conclusion and Outlook
Introduction

Fraunhofer CML’s conducts applied research for the industry

- Fraunhofer CML conducts applied research for the maritime industry
- Activities (amongst others)
  - Navigational safety and risks
  - Decisions support tools
  - Ship-shore-integration
  - Ship management
Introduction
Focus on commercial and navigational ship operations

Sea Traffic and Nautical solutions
- **Topics**
  - Sea traffic’s safety
  - Sea traffic’s efficiency
  - Navigational solutions
- **Tools**
  - Ship handling simulation
  - ENC SDK
  - AIS-data analysis framework

Ship and information Management
- **Topics**
  - Maritime Information Management
  - Ship Management
- **Tools**
  - Mathematical optimization
  - Operations research technologies
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MUNIN’s overview

Key facts of the project

Maritime Unmanned Navigation through Intelligence in Networks

- European FP7 project from Sep 2012 to Aug 2015
- 8 partners with 2.9 million € funding
- Focus:
  - Develop a concept for an unmanned merchant vessel
  - Validate concept in a simulator set-up
**MUNIN’s Aim**
Project definition of the autonomous vessel

**Autonomous ship**

*Next generation modular control systems and communications technology [that] will enable wireless monitoring and control functions both on and off board. These will include advanced decision support systems to provide a capability to operate ships remotely under semi or fully autonomous control.*

**Autonomous ship**

*No persons on board for whole or part of the voyage. The ship, with partial help from remote control, must be able to manage the voyage on its own.*
MUNIN’s Vision
Unmanned deep-sea voyage
MUNIN’s Use Case
Dry bulk carrier on deep-sea-voyage

Reasons:
- Long deep-sea-voyage
- Low risk cargo
- Slow steaming attractiveness
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MUNIN’s navigational systems
Enabling unmanned navigation during deep-sea voyage

Advanced Sensors System
Electronic lookout
- Detect small objects
- Detect weather phenomena

Autonomous Navigation System
Op. decision-making
- Avoid collisions
- Ensure stability in harsh weather

Shore Control Centre
Human element
- Monitor voyage and vessel
- Problem-solving
Autonomous Bridge
Short term use case „Watchfree bridge“

- Autonomous Engine Room
  - Partly unattended engine room already exists
  - Class notation **E0** which is considered to meet the regulations of the *International Convention for the Safety of Life at Sea (SOLAS)* for *unattended machinery spaces* [...]  

- Autonomous navigation can lead towards **B0** „watch-free bridge“
  - Flextime work for nautical officers onboard
  - Improved shore intervention possibilities
  - Less manning possible

- Important date: New SOLAS in 2024
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MUNIN Test-bed
Integrated simulation-based environment

Advanced Sensor System

Shore Control Center
Maintenance Interaction System

Remote Maneuvering Support System

Deep-Sea Navigation System

Engine Monitoring & Control System
Energy Efficiency System

Ship handling simulation
MUNIN Advanced Sensor Module
Sensor fusion approach

COLREG §5
Every vessel shall at all times maintain a proper look-out by sight and hearing as well as by all available means appropriate [...]
MUNIN Advanced Sensor Module
In-situ tests performed in Norway
MUNIN Deep Sea Navigation System
Integration of COLREG and Harsh Weather

Safety and Shipping Review 2014, Allianz

Autonomous Navigation System

- Weather Routing Module
  - Strategic
- Collision Avoidance Module
  - Risk of Collision
  - Immediate Danger

Track Pilot
- Rudder Control
- Engine Control

© Fraunhofer CML
MUNIN Deep Sea Navigation System
Simulation and hardware prototypes
MUNIN Shore Control Center
Human Centered Design

human-out-of-the-loop syndrome

Human Error

If x else
a --> 2.5
b = 1.3.04
MUNIN Shore Control Center
Fully integrated prototype
**MUNIN Test-bed**
Validation methodology

- Sensor emulation
- Four full scale In-situ test
- AIS-Data tests (CA only)
- Ship handling simulation (WR&CA)
- Small-scale in-situ test (CA only)
- HMI-Tests in simulator
- Stresstest in simulator

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AGENDA

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Conclusions
Short-term applications of MUNIN technology developments

Automated Lookout / Watch free bridge
- Single source of reliable data provision
- No reduced lookout capability due to fatigue

Autonomous deep-sea navigation
- COLREG compliance
- Hull and motion monitoring in harsh weather

Shore-side traffic guidance / Watch from shore
- Human-oriented information management
- Remote situation awareness concept

Combination to B0 possible
Outlook

Full validation in the EMSN feasible
Outlook
MUNIN on tour

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<tr>
<th>Date</th>
<th>Event</th>
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<tr>
<td>11.-13.05.2015</td>
<td>Scientific session at COMPIT</td>
<td>Ulrichshusen, DE</td>
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<tr>
<td>03.06.2015</td>
<td>3rd MUNIN Industry Workshop, Norshipping</td>
<td>Oslo, NO</td>
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<td>10.-11.06.2015</td>
<td>MUNIN final promotion event</td>
<td>Hamburg, DE</td>
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<tr>
<td>17.-19.06.2015</td>
<td>Scientific session at TransNav</td>
<td>Gdynia, PL</td>
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Norshipping workshop including participation from RollsRoyce, Maritime Lawyers further more

Final workshop including technical tour through the MUNIN test-bed

Please check also:
www.unmanned-ship.org
Thank you - MUNIN receives funding under FP7-GA314286

MUNIN FINAL EVENT

10th – 11th June 2015 • Hamburg • 53°7,8’N 009°58,1’E

Is unmanned and autonomous shipping feasible?
– And is it desirable?