MUNIN’s Autonomous Bridge

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E-guided vessels: The 'autonomous' ship
Agenda

- General navigation concept
- Approach for autonomous navigation
  - Advanced Sensor Module
  - Deep-Sea Navigation System
  - Remote Manoeuvring Support System
- Short-term applications
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What is navigation?

Navigation can be described as the process or activity of accurately ascertaining one’s position and planning and following a route.
**MUNIN’s main hypothesis:** Unmanned ship systems can autonomously sail on intercontinental voyages at least as safe and efficient as manned ships.

The Autonomous Sensor Module can sense sufficient weather and traffic data to ensure navigation and planning function on autonomous ships and enable situation awareness in an operation room.

The Deep-Sea Navigation System can autonomously navigate a ship safely and efficiently along a predefined voyage plan with respect to weather and traffic conditions.

The Remote Manoeuvring Support System can provide a sufficient vessel track forecast to calculate the limitations of manoeuvrability and assist in direct remote control from a Shore Control Centre.
Operational modes
Main focus on autonomous operation

- Autonomous execution
- Autonomous control
- Remote control

Remote monitoring
Status intervention
Remote control
General navigation concept

The main hazards
Autonomous navigation: Process map
Autonomous navigation: Process map
The general navigation concept

- **Advanced Sensor Module**
  - Automated look-out
  - Detect objects
  - Observe weather phenomena

- **Autonomous Navigation System**
  - Ship operation and decision-making
  - Avoid collisions
  - Ensure stability in harsh weather

- **Remote Manoeuvre Support System**
  - Motion prediction
  - Calculate limitations of manoeuvrability
  - Assist in direct remote control
Agenda

- Use case and general navigation concept
- Approach for autonomous navigation
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Approach for autonomous navigation

Advanced Sensor Module

- Automated evaluation of navigational data
- ASM’s capabilities:
  - Detect objects
  - Classify objects
  - Identify objects
- Single source of information
  - Fusion of data from radar, AIS and visual sensors
Approach for autonomous navigation

Deep-Sea Navigation System

Weather routeing

- Determine optimal route and service speed profile
  - Routeing restrictions, fuel efficiency and safety included
- Avoid unfavorable weather conditions
  - Ship responses optimised
Approach for autonomous navigation
Deep-Sea Navigation System

Collision avoidance
- Prevent close ship to ship encounters
  - COLREG-compliance required
- Evade other obstacles on the ship’s track
  - COLREG-compliance not required
Approach for autonomous navigation
Remote Manoeuvring Support System

- Support SCC during direct remote control
- Provide manoeuvring limits for autonomous control
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Short-term applications

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

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

Shore-side traffic guidance / Shore-based watch
- Human-oriented information management
- Remote situation awareness concept
Thank you for your attention!