Control centre for unmanned ships

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Introduction to MUNIN

Munin ("mind") is one of Odin's two ravens flying out in the morning and reporting news of the world to their master in the evening.

Hugin ("thought"), the other raven, is also the name of a commercially successful autonomous submarine (AUV).

Here, MUNIN is the name of a new EU project researching the unmanned, autonomous ship.
Partners in MUNIN

- Fraunhofer CML (DE) – Research, Coordinator
- MARINTEK (NO) – Research
- Chalmers (SE) – University
- Hochschule Wismar (DE) – University
- Aptomar (NO) – Industry
- MarineSoft (DE) – Industry
- Marorka (IS) – Industry
- University College Cork (IE) - University
Project administrative details

• Duration: 01.09-2012 – 31.08.2015
• Funding: 2.9 million EUR
• Activity code: SST.2012.5.2-5:
  E-guided vessels: the 'autonomous' ship
Use Case:
Dry bulk carrier on deep-sea-voyage

Reasons:
- Long deep-sea-voyage
- Low risk cargo
- Slow steaming attractiveness
An important challenge:

- The *right* level of autonomy
Need a good design for responsibility sharing
Ship-Shore
World wide communication services business model?

http://www.amver.org/
Fallacies of distributed computing

- The network is reliable.
- Latency is zero.
- Bandwidth is infinite.
- The network is secure.
- Topology doesn't change.
- There is one administrator.
- Transport cost is zero.
- The network is homogeneous.

L. Peter Deutsch, SUN Microsystems
Autonomous execution
The main operational mode

- Ship system activities
  - Follow predefined voyage plan
  - Observe environment
  - Measure ship conditions

- Shore Control Centre
  - Monitor ship status

- Communication
  - Periodic updates ship-to-shore
Autonomous control
Handling of known events

• Ship system activities
  – Autonomously adapt voyage plan
  – If required: Involve Shore Control

• Shore Control Centre
  – Ensure safe operation
  – If required: Acknowledge decision

• Communication
  – Event-based data exchange

UAV: Autonomous control

SCC: Monitoring/Investigation
Remote control

Intervention in special situation

- **Ship system activities**
  - Provide navigational data
  - Control is overridden by Shore Control

- **Shore Control Centre**
  - Directly operates ship (remote bridge)
  - If required: Acknowledge decision

- **Communication**
  - Direct link (communication tunnel)
Remote control
Intervention in special situation

- Ship system activities
  - Maintain safety
  - Operate as long as possible

- Shore Control Centre
  - Monitor
  - Start recovery planning

- Communication
  - None

Fail to safe

SCC: Initiate recovery
Challenges for shore control centre design

- well-being
- comfort and ergonomic workspace
- satisfaction
- out-of-the-loop syndrome
- trust in the systems (and equipment redundancy for confirmation or in case of technical failure)
- information overflow
- training and roles
- situation awareness
- loss of ship senses
- capacity for teamwork
Organisation of SCC

**General case (Assumptions)**

1 SCC per 100 vessels
1 operator per 6 vessels
1 supervisor per 30 vessels (5 operators)
1 relieve operator (with workstation for 6 ships) per 30 ships
1 situation room per 30 vessels
1 engineer per 30 vessels
1 captain per 30 ships