

Replacing the nautical navigator

Introduction

The main question of this research is: *"How does a ship with an artificial navigator accomplish its mission independently and safely?"*. This research aims to define the necessary tasks for an artificial navigator. This study is the base for all further research in autonomous shipping.

The tasks

The two main tasks of a navigator are communicating and navigating. In total the navigator has 23 tasks.

Tasks according to the de Bridge Procedure Guide
1. Compliance with the Company's navigational policies
2. Effective watch handovers
3. Management of the Bridge Team
4. Keeping a proper look-out
5. Familiarity with the bridge layout and equipment
6. Familiarity with bridge procedures
7. Maintaining situational awareness
8. Surveillance of the ship
9. Execution of the passage plan
10. Navigation and control of the vessel
11. Collision avoidance in compliance with the COLREGS
12. GMDSS watchkeeping
13. Compliance with environmental requirements
14. Monitoring the performance of navigational equipment
15. Recording bridge activities
16. Management of emergency situations
17. Security awareness
18. Tasks according to the Maritime Industry Knowledge Centre
19. Surveillance of load- and discharge operations
20. Maintenance on safety- and firefighting equipment
21. Performing stability calculations
22. Documenting activities
23. Training the crew
24. Making voyage plans

Navigation

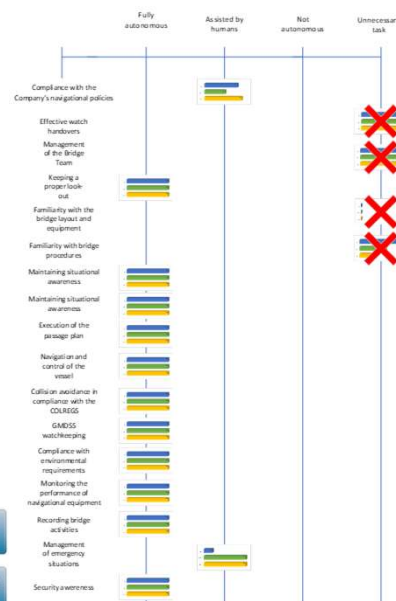
Methods

ALFUS analyses systems on their level of autonomy that can be achieved. Each task will be evaluated on:

- Human independence
- Mission complexity
- Environmental difficulty

Results

The ALFUS-analysis shows that there are 11 tasks that the artificial navigator must perform, 3 that will be performed with the assistance of humans, 4 that will not be performed by the autonomous ship and 5 that will unnecessary for autonomous ships.



Communication

Types

If an autonomous ship wants to communicate she must know which communication happens at sea. The two main communication types are GMDSS-communication and routine communication.



Transmission

Autonomous ship must be able to perform all these types of communication. This can be accomplished with a well working speech recognition and sending software. This will be supported by the AIS of the ship that will show additional information. An interesting benefit of autonomous ships is that in emergency situations they won't require help from other merchant vessels. The message to the right shows an example of a distress signal of an autonomous ship.

MAYDAY – MAYDAY – MAYDAY
This is MV autonoom – MV autonoom – MV autonoom
Papa Alpha Uniform Tango
Message on VHF
MAYDAY
MV autonoom Papa Alpha Uniform Tango
two four five – eight eight niner- zero one eight
My position four niner degrees niner minutes north – zero degrees eight minutes west
I am on fire – fire is in the engine room – I am carrying dangerous goods
I am an autonomous vessel
I require professional assistance
Merchant vessels stay well clear
Out

Conclusion

An autonomous ship can fulfil her mission independently when she can perform the 11 essential navigation tasks and is able to perform GMDSS- and routine communication. If performed correctly safety at sea will be enhanced for the autonomous ship as well as other ships.

Recommendations

The autonomous ship must be capable to think and act like a human officer. Further research to the capability of autonomous systems to act, react and think like humans is necessary. Research to the structure of communication is essential for optimising autonomous communication.