AISS 21
Autonomous Inland
& Short Sea Shipping

Novel assurance framework for autonomous ships

Victor Bolbot, Maritime Safety Research Centre, Department of Naval Architecture, Ocean and Marine Engineering, University of Strathclyde, G4 0LZ, Glasgow, UK victor.bolbot@strath.ac.uk

Gerasimos Theotokatos, Maritime Safety Research Centre, Department of Naval Architecture, Ocean and Marine Engineering, University of Strathclyde, G4 0LZ, Glasgow, UK gerasimos.theotokatos@strath.ac.uk

Lars Andreas Wennersberg, SINTEF Ocean, Postboks 4762 Torgard, Trondheim 7465, Norway lars.andreas.wennersberg@sintef.no

Dag Atle Nesheim, SINTEF Ocean, Postboks 4762 Torgard, Trondheim 7465, Norway dag.atle.nesheim@sintef.no

Jérôme Faivre, BUREAU VERITAS Marine & Offshore, Paris, France jerome.faivre@bureauveritas.com

Abstract

The maritime industry is being rapidly transformed adopting new technologies contributing towards digitalisation and automation. Recent advances and several initiatives [1-6] focus on the design, build and operation of the Maritime Autonomous Surface Ships (MASS). The AUTOSHIP project [7] aims at demonstrating the autonomous technology capabilities, thus pushing the available technology and autonomy levels further on larger size vessels on a short sea shipping vessel and on inland waterway barge.

The introduction of novel MASSs though is accompanied with a number of challenges related to safety, security and cybersecurity. The safety challenges are associated with the increased complexity in MASS and to the interactions between the involved subsystems and the environment [8]. Furthermore, cybersecurity has been an important concern, as cyber-attacks can exploit vulnerabilities in the communication links and directly affect the integrity or availability of the data and control systems, leading to accidents [8, 9]. Various incidences with unauthorised people gaining remote access to the ship control systems have been already reported [10]. Safety concerns and incidences pertinent to piracy or terrorism may pose important concerns.

This study proposes a novel safety assurance framework to support the design of safe, secure and cybersecure MASS. This framework consists of three phases connected to the followed major phases for these assets design (preliminary design, detailed design and verification as well as testing activities) and is aligned to the existing guidance for assurance of MASS and novel technology in the maritime industry. The framework demonstrates good alignment to the existing standards from other industries that can be used for the design of MASS. This study demonstrates how the existing classification societies' guidance and recommended practices can fit into this framework. The proposed framework addresses the main weakness of existing guidance and standards pertinent to the lack of detailed procedures for the testing Key Enabling Technologies (KET), the lack of as standardised approaches for the MASS preliminary risk assessment, as well as the need to enhance the existing maritime safety framework by adopting and marinise pertinent guidelines/methos employed in other industries. Practical examples for applying the framework are accompanying the paper.

Literature

[1] Yara. Yara Birkeland press kit. 2018.
[2] MUNIN. Maritime Unmanned Navigation through Intelligence in Networks. 2016.
[3] AAWA. AAWA project introduces the project's first commercial ship operators. 2016.
[4] Daffey K. Technology Progression of Maritime Autonomous Surface Ships. 2018.
[5] AEGIS. What if marine automation can take waterborne transport to the next level? 2021.
[6] RECOTUG. SVITZER, KONGSBERG Maritime and ABS join forces to develop the world's first commercial tug to be fully remotely controlled. 2021.
[7] AUTOSHIP. Autonomous Shipping Initiative for European Waters. 2019.
[8] Bolbot V, Theotokatos G, Bujorianu LM, Boulougouris E, Vassalos D. Vulnerabilities and safety assurance methods in Cyber-Physical Systems: A comprehensive review. Reliability Engineering & System Safety. 2019;182:179-93.
[9] Eloranta S, Whitehead A. Safety aspects of autonomous ships. In: Gl DNV, editor. 6th International Maritime Conference. Germany, Hamburg2016. p. 168-75.
[10] Wingrove M. Shipborne systems most vulnerable to cyber-attack. Marine electronics & communications. United Kingdom, Enfield: Riviera Maritime Media Ltd; 2017. p. 27.