TYPE Editorial
PUBLISHED 24 November 2023
DOI 10.3389/fmars.2023.1336722

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EDITED AND REVIEWED BY
Hervé Claustre,
Centre National de la Recherche Scientifique (CNRS), France

*CORRESPONDENCE
Kun Yang
yangkun@zjou.edu.cn

RECEIVED 11 November 2023
ACCEPTED 17 November 2023
PUBLISHED 24 November 2023

CITATION
Yang K and Røste T (2023) Editorial: Maritime broadband communications and networking.
Front. Mar. Sci. 10:1336722.
doi: 10.3389/fmars.2023.1336722

Editorial: Maritime broadband communications and networking

Kun Yang[1*] and Terje Røste[2]

[1]Ocean Connectivity Lab, Zhejiang Ocean University, Zhoushan, China, [2]Super Radio AS, Oslo, Norway

KEYWORDS

maritime radio channel measurement and modeling, underwater acoustic, collision avoidance, evaporation duct, LEO satellite, IoT communications

Editorial on the Research Topic
Maritime broadband communications and networking

Introduction

As development, production, and services become increasingly digital, the maritime economy is undergoing a process of transformation. Digitalization in the ocean industry is therefore regarded as one of the most significant global trends. The digitalization of numerous maritime activities, such as oil extraction, autonomous shipping, maritime transportation, and fish farming, which continue to be rapidly developed, will become a decisive competitive factor for the entire maritime sector and generate a vast quantity of ocean data. The implementation of these processes relies on nationwide broadband and mobile radio networks with high data transfer capabilities, broad coverage, and high stability, which necessitates the development of new broadband maritime communication technology.

The objective of this Research Topic is to accelerate the new research on maritime broadband communications and networking including underwater acoustic, maritime radio channel measurement and modeling, maritime satellite systems, and related applications like collision avoidance.

Contributing articles and main conclusions

This Research Topic has six published papers in total. These papers are of high quality and address many different aspects of maritime networking and broadband communications. Li et al. aimed to address the impact of changing ocean waves on a maritime radio channel. To study the impact, sea surface morphology models under multiple wind speeds was built. Moreover, the Monte Carlo method is employed to estimate the path loss in the same area under different sea conditions. Jiao et al. presented a high-precision direction of arrival (DOA) estimation method with underwater acoustic signals based on sparsity adaptation, which is used to predict DOA in scenarios where the number of underwater sound sources are unknown. The aim is to solve the problem of DOA estimation method based on compressed sensing theory which is constrained by source sparsity, and to improve the prediction accuracy and stability of the algorithm in different scenarios. Wang et al. presented a novel intelligent collision avoidance algorithm based on approximate representation reinforcement learning to realize the collision avoidance of maritime autonomous surface ships in a continuous state space environment. The aim is to solve the problem of large-scale collision avoidance policy learning in static-dynamic obstacles mixed environment. Raulefs et al. have addressed how to model the maritime radio channel over a rough sea surface, and they have also performed measurement campaigns to verify the model. Focus is on the frequency bands below 6 GHz that are crucial for maritime broadband communications and navigation. Spatial modelling of the sea surface is based on a two-dimensional Gaussian stochastic process and a stochastic temporal evolution of the sea surface characterized by a time correlation function. The model has been applied to the sea area around the Helgoland Island outside Germany. This scenario contains both a fixed land scattering surface and scattering from a stochastically always moving sea surface for ship-to-ship communications. The model has been verified by measurement campaigns using a channel sounder. It is shown that the model can reproduce the measured channel with good accuracy as the dominant radio ray components are well described by the model. The prediction of channel properties is of crucial importance for maritime operation in harsh sea conditions. This knowledge may also be exploited for optimum design of radio and antenna solutions. Wang et al. have investigated the over-the-horizon microwave channel over the Yellow Sea where the conditions for evaporation ducts may occur. They have performed long-term measurements and statistical analysis of the measurement results. The measurements are made at 9.4 GHz over a distance of 133 km in the Yellow Sea. The paper explains the evaporation duct model with humidity, pressure, temperature and curvature of the earth as parameters. The comprehensive statistical analysis compares measurements with weather parameters (temperature, wind speed, humidity etc.) over the seasons with path losses and summarize when the broadband communications are advantageous. Røste et al. have studied IoT communications from a LEO satellite to a buoy and vice versa in the Arctic Sea. They have modelled and analyzed the different propagation mechanisms for the radio path between a LEO satellite at height 800 km and a buoy floating on the sea surface. The propagation loss mechanisms that are included are 1) free path loss, 2) scintillations caused by the ionosphere, 3) absorption in the troposphere, 4) diffraction caused by the round earth at low elevation angles 5) scattering from the moving sea surface. Link budget analysis contain these loss mechanisms and realistic radio front end parameters of the buoy and the satellite and a data rate of 100 kbit/sec. It has been concluded that the link budget from the buoy to the satellite is critical, communication is not possible at low elevation angles. With only one LEO satellite the data transfer is intermittent and of duration in the order of 10 minutes and lower depending on the position of the buoy, on the sea surface and the satellite orbit.

Author contributions

KY: Writing – original draft, Writing – review & editing. TR: Writing – original draft, Writing – review & editing.

Funding

The author(s) declare financial support was received for the research, authorship, and/or publication of this article. This work was supported by Basic Scientific Research Fund of Zhejiang Provincial Universities under Grant No. 2021JD004.

Acknowledgments

We are grateful to all authors and reviewers for their hard work on this Research Topic, on behalf of the Guest Associate Editors. We anticipate that this will stimulate more research into maritime broadband communications and networking.

Conflict of interest

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