DEVELOPMENT OF AN INTELLIGENT DECISION SUPPORT SYSTEM FOR SHIP MOVEMENT MANAGEMENT CONSIDERING SHIP OPERATOR FATIGUE

Conference Paper · May 2023

CITATIONS
0

READS
38

4 authors:

Pavlo Nosov
Kherson State Maritime Academy
266 PUBLICATIONS **1,604** CITATIONS
SEE PROFILE

Oleksiy Koretsky
Kherson maritime state academy
11 PUBLICATIONS **5** CITATIONS
SEE PROFILE

Onyshko D.M.
3 PUBLICATIONS **0** CITATIONS
SEE PROFILE

Makarchuk D. v.
5 PUBLICATIONS **96** CITATIONS
SEE PROFILE

UDC 004.58

DEVELOPMENT OF AN INTELLIGENT DECISION SUPPORT SYSTEM FOR SHIP MOVEMENT MANAGEMENT CONSIDERING SHIP OPERATOR FATIGUE

NOSOV P.S.
KORETSKY O.A.
ONYSHKO D.M.
MAKARCHUK D.V.
pason@ukr.net
Kherson State Maritime Academy

Abstract. This study investigates the development of an intelligent decision support system, considering fatigue parameters, to ensure safe and efficient ship navigation. Addressing the issue of ship operator fatigue and effective decision-making can lead to increased maritime safety and reduced accident risk.

Introduction. In the context of modern maritime transport, one of the main tasks is ensuring the safety of navigation and the efficiency of ship movement. One of the causes of accidents and incidents is the loss of concentration by the ship operator due to fatigue [1]. The development of an intelligent decision support system that takes fatigue parameters into account has significant scientific and practical value.

Problem Statement. Addressing the problem of ship operator fatigue and ensuring effective decision-making support is a relevant task, as it contributes to increased maritime safety and reduced accident risk [2]. The application of an intelligent decision support system, considering fatigue parameters, can significantly improve the quality of ship movement management, providing scientific and practical innovation for the maritime transport industry.

Main Part and Essence of the Study. To achieve the overall goal of ensuring safe ship movement management, it is important to conduct a series of research. Analyzing scientific research, articles, and reports on the problems of loss of concentration and fatigue will allow us to identify the main factors affecting these phenomena and assess their impact on maritime safety. By focusing on the review of existing methods for identifying fatigue parameters and their application methodology in the maritime sector, the suitability of these methods for this sphere can be evaluated, and directions for their adaptation and improvement can be determined.

Investigating decision support systems in the field of safe ship movement management through the study of literature, scientific research, and reports on this issue will help assess the advantages and disadvantages of existing systems and identify possible directions for their development and improvement. Identifying problems that arise when supporting decision-making under uncertainty of influencing factors on the ship operator's actions, and analyzing situations with insufficiently defined influencing factors, will facilitate the development of a methodology for decision-making support under such conditions.

To achieve the scientific goal of improving maritime safety, it is necessary to perform a series of reasoned research: conduct a review of modern risk management methods, including the analysis of scientific publications, articles, and research, evaluation of the efficiency and limitations of different methods, and identification of potential development directions; develop a risk management methodology related to the emergence of ship operator fatigue, define risk assessment criteria, develop a methodology for identifying and assessing such risks, and analyze parameters that affect the ship operator's fatigue; develop mathematical models of fatigue parameters and algorithms for their identification, including defining mathematical dependencies, developing algorithms, and verifying the adequacy of the developed models.

In the next stage, it is necessary to develop software for monitoring fatigue parameters, integrate the developed methods into an intelligent decision support system, and conduct testing in real operating conditions. After that, analyze and compare the efficiency of the developed methods with

existing ones, collect efficiency data and conduct a comparative analysis, identifying the advantages and potential drawbacks of the developed methods.

The final step will be assessing the effectiveness of applying the developed methods for enhancing the safety of ship movement management, analyzing the implementation results on real vessels and identifying the impact of the developed methods on the safety level of ship movement management. Draw conclusions on the possible contribution of the developed methods to improving maritime safety and make recommendations for further improvement of methods that can promote safe vessel operation and reduce risks associated with ship operator fatigue [3-6].

To develop an effective device for identifying ship operator fatigue, it is first necessary to analyze the theoretical foundations and modern methods of applying PID controllers. By studying the basic principles of their operation and application in other industries, a review of scientific research and publications dedicated to the use of PID controllers in the context of fatigue detection can be conducted.

Based on the obtained information, develop a concept and architecture of an electronic device for fatigue identification, including the development of schematic representations of the device, taking into account the requirements for ergonomics and user convenience, as well as the technical specifications of the electronic device. After that, determine the requirements for sensors and hardware of the device, selecting the optimal sensors and detectors for detecting fatigue parameters, evaluating the accuracy, sensitivity, and working range of sensors, and establishing requirements for processors, memory, and other hardware components.

Considering the selected components, develop algorithms and software for PID controllers in the context of fatigue indicator identification, including algorithms for processing data from sensors, constructing fatigue models, and developing a user interface for displaying analysis results. The next step will be testing the developed electronic device on both model and real data during vessel movement, conducting a series of tests to verify the operation of algorithms and software, as well as organizing experiments with real sailing participants to detect fatigue indicators and evaluate the device's effectiveness. Analyzing the obtained results will help make appropriate adjustments to the algorithms and software.

After testing and fine-tuning the developed device, analyze the effectiveness of using the device for identifying fatigue indicators in real sailing conditions. Evaluate the impact of using the device on the safety level of sailing and reducing the risk of accidents associated with ship operator fatigue. Additionally, examine user and expert feedback regarding the convenience and practicality of using the device. This will allow for summarizing the research and formulating recommendations for further improvement of the device and fatigue indicator identification system. Thus, the developed device can become an important tool for ensuring safety on the water and reducing risks associated with ship operator fatigue.

Conclusion. The development of an intelligent decision support system for ship movement management, considering ship operator fatigue parameters, is a relevant and promising research direction. Implementing such a system will contribute to improving sailing safety, reducing the risk of accidents, and providing scientific and practical novelty for the maritime transport industry.

REFERENCES:

1. P.S. Nosov, S.M. Zinchenko, A.P. Ben, Y.A. Nahrybelnyi, and O.M. Dudchenko, "Models of decision making by a navigator under implicit agreements with COLREG rules," Науковий вісник Херсонської державної морської академії : науковий журнал, no. 1(20), pp. 31-38, 2019.

2. P. Nosov, G. Krapyvko, A. Ben, M. Safonov, and S. Zinchenko, "Disabling the dynamic positioning of the vessel as a cause of the negative influence of human factor in maritime transport," in МНПК пам’яті професорів Фоміна Ю. Я. і Семенова В. С. (FS - 2019), Odessa-Stambul-Odessa, 2019, pp. 309-315.

3. P. Nosov, S. Zinchenko, V. Plokhikh, I. Popovych, Y. Prokopchuk, D. Makarchuk, P. Mamenko, V. Moiseien-ko, and A. Ben, "Development and experimental study of analyzer to enhance maritime

safety," Eastern-European Journal of Enterprise Technologies, vol. 4, no. 3 (112), pp. 27-35, 2021. https://doi.org/10.15587/1729-4061.2021.239093.

4. S. Zinchenko, O. Tovstokoryi, P. Nosov, I. Popovych, and K. Kyrychenko, "Pivot Point position determination and its use for manoeuvring a vessel," Ships and Offshore Structures, vol. 18, no. 3, pp. 358-364, 2023. https://doi.org/10.1080/17445302.2022.2052480.

5. I. Popovych, O. Blynova, J. L. Nass Álvarez, P. Nosov, and S. Zinchenko, "A historical dimension of the research on social expectations of an individual," Revista Notas Históricas y Geográficas, no. 27, pp. 190-217, July-December 2021.

6. П. С. Носов, В. М. Тонконогий, and О. Є. Яковенко, "Застосування адаптивних функцій для впливу на модель знань студента," Тр. Одес. політехн. ун–ту, вип. 1 (25), pp. 118-122, 2006.