PECULIARITIES OF IDENTIFICATION OF THE PSYCHO EMOTIONAL STATE TO NAVIGATORS DURING OF NAVIGATION WATCH

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Introduction. One of the important stages of navigational watch organization is the formation of a team taking into account behavioral characteristics for making managerial decisions [1]. This approach is determined by safety measures in accordance with international standards and regulations [2].

During the control of the vessel, both in real conditions and during the training simulator, a number of difficulties arise associated with the negative manifestation of the human factor [3-5]. Such manifestations are directly reflected in the passage of locations and other maneuvers [6,7] at the time of the command of the vessel's crew on the captain's bridge.

The situation is complicated by the fact that in addition to factors directly affecting each specialist [8,9], there are factors of influence from team members. The more complex the task and the features of the location, the more a boatmaster encounters a large number of information signals.

At the time of decision-making, the number of such information signals may exceed the threshold of perception [10], which leads to loss of concentration and, as a result, increases the subjective entropy of the skipper [11]. World practice indicates that the human factor remains the most common cause of disasters in maritime transport and at present [12].

Purpose of the study. Thus, the purpose of this article is to consider the causes of the negative manifestation of the human factor at the time of navigational watch. At the same time, three environments are considered to identify the negative manifestation of the human factor in maritime transport:

– interactions of team members on the captain's bridge;

– identification of the stress state of the skipper at the time of making decisions;

– the complexity of the location in the performance of navigation tasks.

The relevance of research. The solution of the assigned tasks of the assigned tasks will allow approaching the issues of improving safety in maritime transport at a qualitatively new level.

Based on the developed hardware and software tools for identifying members of the watch service, it becomes possible to more effectively manage the process of training skippers during training simulations based on the NTPRO 5000 navigation simulator at the Kherson State Maritime Academy. These studies can also be useful in studying the discipline "Organization of crew actions in extreme conditions."

The main research material. We perform analytical modeling of the situation in terms of set theory and theory of logic. Suppose that at the time of the watch, local interactions of short duration occur between members of the watch and the watch officer (captain).

We will assume that two subjects are involved in the interaction: W is a deck officer or a captain and M is a member of the personnel on duty. In this example, the captain instructs before the start of the passage of the location, and immediately at the time the first mate takes command.

Thus, the participant at number 5 (the captain) does not participate in team interaction, but can prompt the first mate. Each watch interaction solves the micro-task of steering the vessel at the current moment. For each problem n we assign a sequence $u_i, i = 1,\dots,n$.

Members of the watchkeeping duty W and M are divided into homogeneous groups $W_1,\dots,W_{\overline{Q}}$ and $M_1,\dots,M_{\overline{S}}$ on the level of qualification (experience).

This leads to the formation of groups $W_R,\ M_S$ associated with problems of type i and bringing the result $C_i^R,\ \overline{C}_i^S$.

Creating the model. To describe the model, let us set: the set of I different groups of interaction between the members of the watchkeeping duty; the numbers $N^Q,\ Q \in I$ of these groups; the set $H = \{\psi\}$ of possible types of interactions, where $\psi = \langle Q(1,\psi),\dots,Q(m(\psi),\psi)\rangle,\ m(\psi)$ – the number of participants in interactions, $\psi,\ Q(i,\psi) \in I$ – the group to which the participant with the number i belongs; function $\vartheta(\psi)$, indicating for $\psi \in H$ the value of the effectiveness of the micro-task, united into ψ interaction.

We denote by $\langle Q \rangle$ the type of interaction corresponding to the individual member of the watch Q, who is not united with anyone.

At the same time he can be a deck officer with extensive experience and ignoring the members of the watchkeeping staff or an unclaimed member of the duty personnel due to low qualification, then $\forall Q \in I \langle Q \rangle \in H,\ \vartheta(\langle Q \rangle) = 0$.

Thus, there is a high probability of an imbalance in confidential dialogue between members of the watch service.

All this leads to the need to track such negative manifestations in order to prevent disasters in maritime transport.

Conducting an experiment. In order to confirm the hypothesis that the given local interactions directly affect the quality of control of the vessel, an experiment was conducted (Fig. 1).

The figure shows the trajectory of the transition through the Bosphorus Strait at the time of the occurrence of undesirable local interaction on the navigation bridge.

As can be seen from the trajectory, fluctuations occurred at the moment of choosing the strategy for performing the maneuver, which could trigger a catastrophe (Fig. 2).

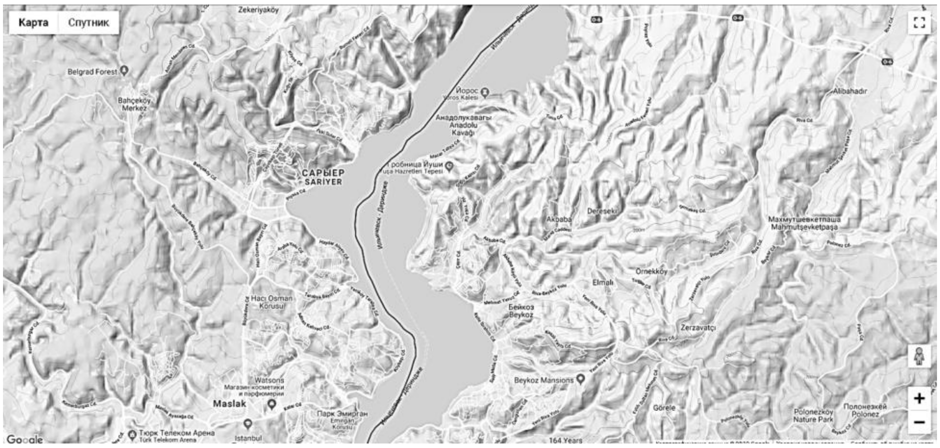


Figure 1. Passing a dangerous turn in the Bosphorus

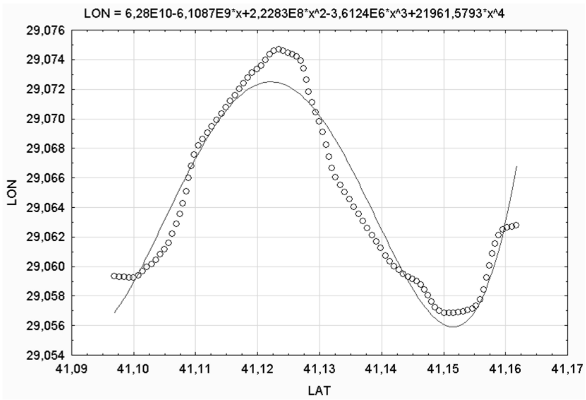
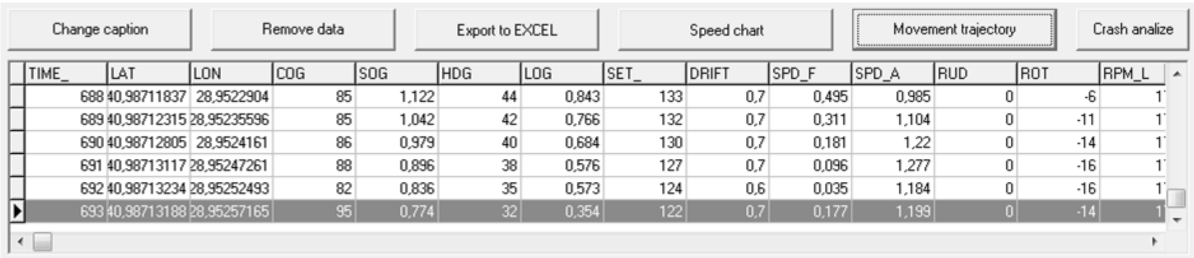


Figure 2. Trajectory analysis

After analyzing the data from the NTPRO 5000 navigation simulator server, a graph was built of the dependences of the speed and rotation of the rudder pen relative to the time of the location using the developed automated tools (Fig. 3).



TIME_	LAT	LON	COG	SOG	HDG	LOG	SET_	DRIFT	SPD_F	SPD_A	RUD	ROT	RPM_L
688	40,98711837	28,9522904	85	1,122	44	0,843	133	0,7	0,495	0,985	0	-6	1
689	40,98712315	28,95235596	85	1,042	42	0,766	132	0,7	0,311	1,104	0	-11	1
690	40,98712805	28,9524161	86	0,979	40	0,684	130	0,7	0,181	1,22	0	-14	1
691	40,98713117	28,95247261	88	0,896	38	0,576	127	0,7	0,096	1,277	0	-16	1
692	40,98713234	28,95252493	82	0,836	35	0,573	124	0,6	0,035	1,184	0	-16	1
693	40,98713188	28,95257165	95	0,774	32	0,354	122	0,7	0,177	1,199	0	-14	1

Figure 3. Analysis of the passage database for 14 parameters.

All this indicates that at the time the navigation watch was carried out, local interactions between the two members of the watch were ignored, ignoring the rest. As a result, an incomplete understanding of the situation led to chaotic actions when performing the maneuver, which is not permissible. An additional medical diagnostic equipment was used, which recorded pulse surges and increased oxygen in the blood at the time of the maneuver (Fig. 4).

An analysis of the trajectories also indicates that during course of the maneuver, the strategy and indications of the speed and steering angle changed repeatedly, which is confirmed by medical measurements.

Figure 4. Identification of stress navigator

The physiological state sensors are connected to the control unit by electrical and information wires to transmit data and process it in the control unit according to a predetermined algorithm for the formation of warning audio and visual alarms. When the critical indicators of psycho-emotional state are detected, the processed data is transferred to the remote server for management decisions and correction of the navigator's actions.

The setting of the sensors and making the necessary connections is performed by a healthcare professional. It also installs the program and determines the critical performance of the sensors.

The use of medical analyzers allows to determine the psycho-emotional state of the navigator while carrying the watch, which allows to prevent the consequences of the negative manifestation of the human factor in maritime transport.

The development of automated analysis involves communication with the controller on the bridge, so there is a need to select a microcontroller and sensors to measure the emotional state of the navigator.

According to the results of experimental studies, on March 11, 2019 a patent was obtained for the utility model "Analyzer of psycho-emotional state of the navigator" № u132741.

With the help of the developed analyzer it is planned to conduct a number of experiments to determine the psycho-emotional state of navigators during critical situations on maritime transport by means of the NTPRO 5000 navigation simulator at the Kherson State Maritime Academy.

Conclusions. During the implementation of navigational hauls and maneuvers, the formation of established interactions between members of the watch is possible, which depends on the level of experience and qualification. The experiment showed that these interactions violate the rules of keeping watch and localizes such groups from other boatmasters. In order to prevent negative consequences, software has been proposed and tested that allows identifying localizations that negatively affect the performance of ship control tasks.

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