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SUMMARIES

E.M. Appolonov, M.N. Bogdanov, I.K. Boroday, G.V. Vilenskiy, V.G. Platonov, Y.S. Kaytanov, B.N. Smirnov. **Modern technologies to support investigations and high sea-keeping capabilities of the moored structures intended for hydrocarbon production.** Pp. 7–18.

Authors examine aspects of carrying out sea-keeping tests in the towing tank with objects equipped with extended anchor mooring systems in intensive irregular waves. New simulation technology of the positioning systems based on the truncated lines is described. Technology of designing such systems is the Institute's «know-how» and provides accounting of main features of similarity for the dynamics between the moored object and its model during testing. To provide simulation of the extreme wave conditions (100- and 1000 year storms), the authors propose technology of generating intensive irregular waves with simultaneous operation of two wave-makers. New technologies significantly increase capabilities of the Sea-keeping basin in carrying-out model tests, raise reliability and accuracy of estimations of the moored object dynamics in waves. These technologies were used to estimate sea-keeping properties of the complex marine structures intended for hydrocarbon field development at Russian shelf.
Key words: *towing tank, sea-keeping capability, irregular waves, technology, marine structures.*

Y.S. Kaytanov, V.V. Magarovskiy. **Estimation of the ship sea-keeping properties in extreme navigation conditions.** Pp. 19–30.

Widely applied spectral method for calculating motions in irregular waves is based on the linear theory and provides acceptable results in the conditions of weak and moderate waves. When deck is flooded and hull bottom is emerged in the conditions of intense waves, it is required to consider non-linearity in interaction between fluid and ship hull. To account this non-linearity, it is required, first, separate hydrodynamic forces on components more reasonably and, second, consider instant wetted surface, when integrating these components over it. The article describes developed mathematical model of the non-linear vessel motions in details, which takes into account the mentioned factors, and demonstrates some practical outcomes that are made basing on investigation of non-linear factor effect on motions parameters.
Key words: *irregular waves, non-linearity, mathematical model.*

A.N. Kulikova, S.V. Schegorets. **Experimental investigation of wave drift forces effecting ship in regular and irregular wave conditions in blue and shallow waters.** Pp. 31–40.

The article describes results of the experimental study of the wave drift forces that affect vessel in regular and irregular waves in the blue and shallow water conditions. In course of experiment lengths of regular waves, characteristics of the irregular waves and heading angles of waves were varied. Results of direct physical simulations on determining mean values of the wave drift forces in irregular waves are compared with results of calculations performed on the basis of experiment in regular waves. The authors examine method of determining variable component of the wave drift forces that allow obtaining spectral and statistical characteristics of the low-frequency component of the wave drift forces.
Key words: *drift forces, irregular waves, regular waves, blue waters, shallow waters.*

V.V. Magarovskiy. **Approximation of actual waves in solving non-linear problems of the ship dynamics.** Pp. 41–46.

To increase accuracy of results in solving problems of ship dynamics, it is required to use non-linear models, in particular, conduct calculations in time domain in actual sea waves.

Input of irregular waves in different methodology is done through its presentation as series of N regular harmonics. At that, this value changes from 7 to 200. Therefore, the purpose of this article is determining of minimum acceptable number of harmonics to approximate irregular waves in the software product KBA being developed that would allow accounting the most important non-linear features of the ship motions and processes imposed by these motions.

The article provides examples of approximations for sea wave spectra with different numbers of regular harmonics. Basing on these examples, conclusions regarding approximation accuracy and minimum number of regular harmonics required to input actual sea waves in the software product being developed are made.

Key words: *irregular waves, regular harmonics, sea wave spectra, non-linear ship motion.*

A.V. Ivanov, A.N. Kulikova. **Development of methodological grounds for physical dimulation of the system «marine offloading terminal–tanker» in current, wind, wave and shallow water conditions.** Pp. 47–58.

The authors examine methodological issues of physical simulation of the technological operation for hydrocarbon offloading from stationary platform on the moored to it tanker in wind, current, wave and shallow water conditions the sea-keeping basin. The article formulates main technical tasks that are required to be solved through physical simulation to provide safety of the hydrocarbon offloading in the open sea. Some results of the experimental determining of the kinematics parameters of the moored tanker movement relative to the stationary berth are given.

Key words: *marine offloading terminal–tanker, tanker, hydrocarbon offloading, physical simulation, irregular waves, current, statistical properties.*

V.G. Platonov, M.S. Trub. **Experimental investigation of the marine floating wind power plant behaviour in the intensive waves.** Pp. 59–64

The article examines perspectives of applying marine wind power plants (MWPP) as one of possible ways to use renewable energy sources. Original architecture of the floating platform with shape of the hollow isoscales triangle is proposed. Sea-keeping tests of this platform are performed in intensive irregular waves with wave height of 3 % occurrence up to 13 m. Obtained data of the MWPP dynamics in waves allow formulating proposals intended to reduce environmental effect on the platform and increase safety and efficiency of its operation.

Key words: *wind power plant, floating platform, irregular waves, pitching, statistical properties, spectral characteristics.*

S.B. Abaturov, A.N. Kulikova. **Estimation of maximum values possible in large realisation over maximum values obtained in small size sample capture.** Pp. 65–74.

The article examines method of estimating extreme values in the sample capture of very large size over maximum values obtained in the small size sample capture. This method is based on well-known methodology of indirect determination of dispersion using asymptotic properties of the maximum (minimum) distribution in the arbitrary processes. At that, reverse problem is being solved. It is demonstrated that in experimental determination of the process standard over small size sample capture

(N = 8–50) it is possible to reliably estimate maximum values of amplitudes in the large size sample capture with unknown law of amplitude probability distribution. The article provides experimental data regarding estimations of the tanker model tests that is moored to the stationary marine berth through one line. Significance of obtained results is estimated. Experimental data do not contradict with proposed hypothesis. The article materials could be used in estimations of maximum amplitude values in the sample capture of very large size.

Key words: *amount of sampling, extreme values, standard, confidence assessment.*

I.K. Boroday, V.V. Yarisov. **Design and regulatory support of navigation safety for low-tonnage vessels in deck flooding conditions, when vessel moves in following waves.** Pp. 75–82.

The article proposes design method for estimating stability of low-tonnage vessels with length up to 45 m, which is based on theoretical and experimental studies. The vessels have continuous steel bulwarks and stern part of the deck that is not protected by afterdeck and other stern superstructures, when the deck is flooded during ship movement in following waves. The article demonstrates results of the experimental check-out of the proposed stability norm. Results of this work are used in routine practices of the Russian Maritime Register of Shipping regarding development of the Classification and Construction Rules for the sea fishing vessels with regard to the increase of the requirements to the parameters of the static stability diagram.

Key words: *following waves, heeling moment, overturn, stability, regulation.*

B.N. Smirnov, M.N. Bogdanov. **Experimental study of sea-keeping qualities for the moored semisubmersible double-hull drilling platform in irregular waves.** Pp. 83–90.

The article provides results of model tests with moored semisubmersible double-hull drilling platform in irregular waves. The authors examines methodology aspects of the sea-keeping tests of moored objects in the conditions of intensive irregular waves in the towing tank. Materials of the experimental study could be used in designing semisubmersible platforms of the examined type and estimations of their operational safety in different wave conditions including extreme survival conditions.

Key words: *drilling platform, navigability, irregular waves, pitching, spectra.*

V.Y. Semenova, R.V. Borisov, I.K. Boroday. **Determination of hydrodynamic characteristics of the ship hulls to calculate non-linear motions in waves.** Pp. 91–98.

The article examines solutions for differential equation system describing transverse vessel motions considering non-linear forces of the second order. The authors provide results of calculating the RAOs of the transverse motions types accounting these forces. In case of transport vessel, the authors demonstrate significant effect of the non-linear factors in the area of superharmonic resonance modes. The article proposes atlas of tables to determine the non-linear forces.

Key words: *non-linear forces, rolling, added mass, damping, amplitude-frequency characteristics, resonance, phase-frequency characteristics.*

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