DESCRIPTION
OF THE HYDRODYNAMIC PRESSURE FIELD FUNCTION AROUND THE SHIP HULL

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The article presents the results of approximation calculations of the vacuum field hydrodynamic around the ship, calculated by finite element method. The control points in the middle panels distributed on the hull of the ship, on the surface of the seabed and the free surface singularities are placed in the form of spatial resources and discounts, or dipoles. Presented results of the calculations have been obtained using this first singularity. Then, using the observed field properties proposed approximation of hydrodynamic pressure distribution functions: polynomial of the ninth grade after the ship's length and the width of the exponential function, which can significantly reduce the amount of numbers needed to describe the field. For a given depth to about 20, and the entire field space can be described in a matrix of approximately 200 numbers.

INTRODUCTION

Field hydrodynamic vacuum which produces a ship sailing is a function of distance from the ship – r, the speed of its movement – v and depends on the shape of the hull. Approximate description of the hull shape are the main dimensions (L, B, T) and field distribution frames described in the function of the ship length. Detailed description of the shape of the ship hull is a table of ordinates or theoretical lines of the ship.

1. THEORETICAL EXAMINATION

For a description of the vacuum field will use the parameters a_i illustrated in the following Fig. 1. They describe the value of the vacuum in the plane of ship symmetry at a given depth $H1$, the seabed at a depth H, at a given constant speed of the ship v. Values of (x_i, a_i) describe the points – the nodes defining the extremes, and the nodes where the vacuum value is zero and at least one node for $x > L/2$ oraz $x < -L/2$. All these values will be used to calculate the polynomial form W_9 (x), describing the change in value of negative hydrodynamic pressure in the symmetrical plane of the ship.

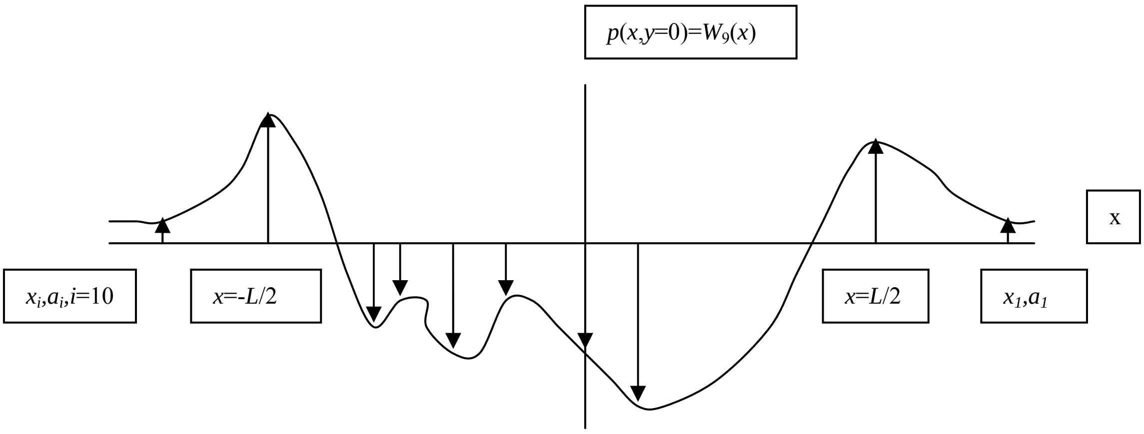

Fig. 1. Figure vacuum field in the plane of ship symmetry (SS); a_i parameters describe him as a ninth degree polynomial W_9 (x)

As is apparent from the data obtained from field measurements and hydrodynamic calculations, pressure distribution in the plane perpendicular to the SS along the y-axis decreases exponentially from the value of p (x, y = 0) = W_9 (x) in the SS to the value of $a_7(x)$ at a distance k * B from the SS. The nature of these functional dependencies is shown in Figure 2 and 3.

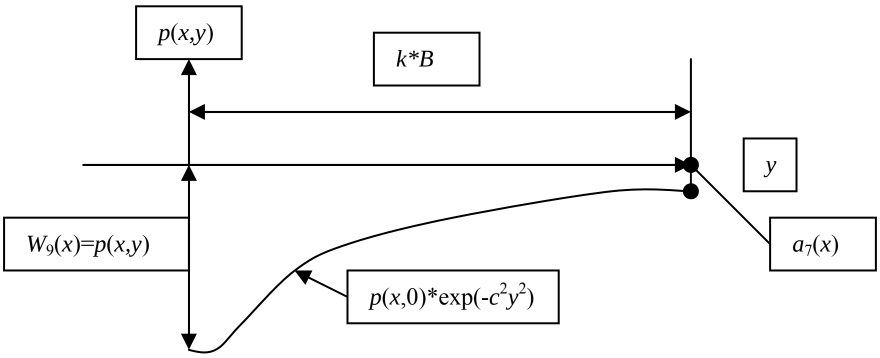

Fig. 2. Figure vacuum field in the plane perpendicular to the plane SS is an exponential curve and the form: $p(x,0)*\exp(-c^2*y^2)$

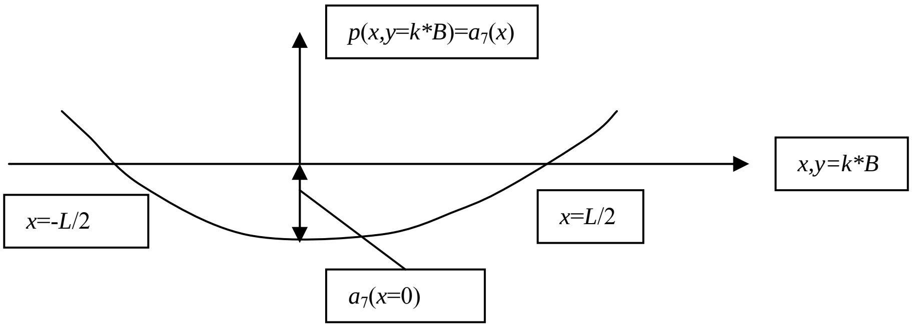

Fig. 3. Figure vacuum field in a plane parallel to the plane SS, drawn at a distance y = k * B from the SS; curve is a polynomial of second degree $W_2(x)$

The function $W_9(x)$ of a vacuum field values of hydrodynamic (VFH) at a given depth in the SS can be compared with its simpler form for greater depth $H1 = H = 60$m to Fig. 5. The nature of exponential fields VFH in the transverse direction to the SS on the above depth illustrates the Fig. 6. Using these functions, illustrated in Figure 1 and 2, the field VFVH can be presented in the form as follows:

$$p(x, y) = W_9(x) * \exp(-c^2 * y^2) \tag{1}$$

After the transformation of relationships and determine the coefficient c, using the function $p(x, y = KB)$ presented in Fig. 3, VFH approximated dependence becomes a:

$$p(x, y) = W_9(x) * \left[\frac{a_7(x)}{W_9(x)}\right]^{\frac{y^2}{k^2 B^2}} \tag{2}$$

where:

$$a_7(x) = a_7(x = 0) * [1 - 4 * \frac{x^2}{L^2}] \tag{3}$$

In further calculations of approximation will be used VFH in a form (2).

2. THE RESULTS OF CALCULATION, SIGNATURE AND ITS APPROXIMATION

Some results will be presented to the ship calculated SVFH program, (signature of vacuum field hydrodynamic). Vacuum field hydrodynamic at the bottom with a depth of 60 m shows Fig. 4.

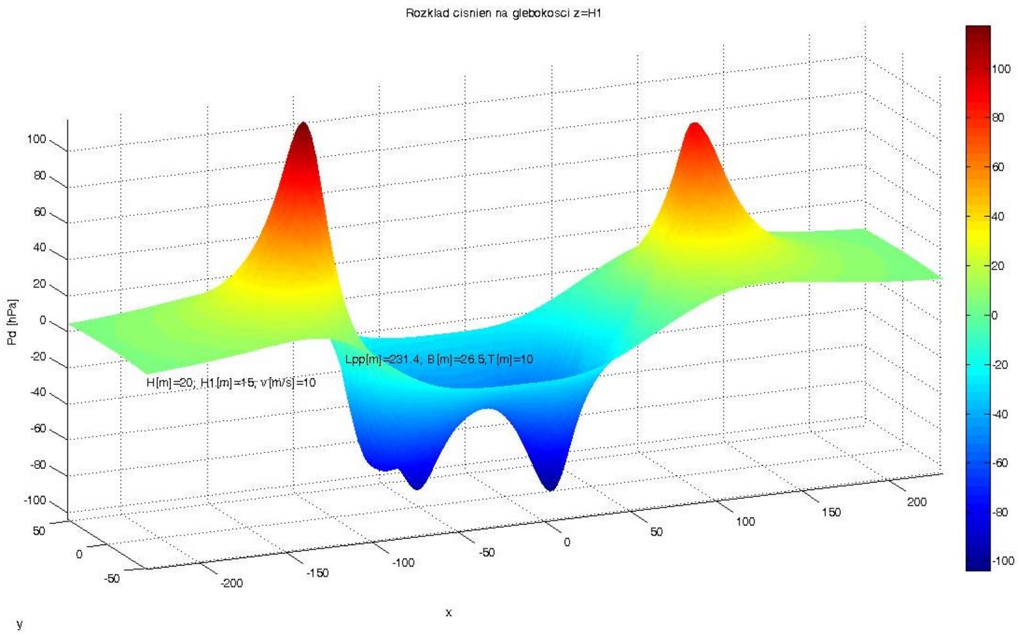

Fig. 4. Vacuum field hydrodynamic calculated for the depth $H1 = 15$ m, the bottom depth $H = 20$, under the ship, with the program SVFH

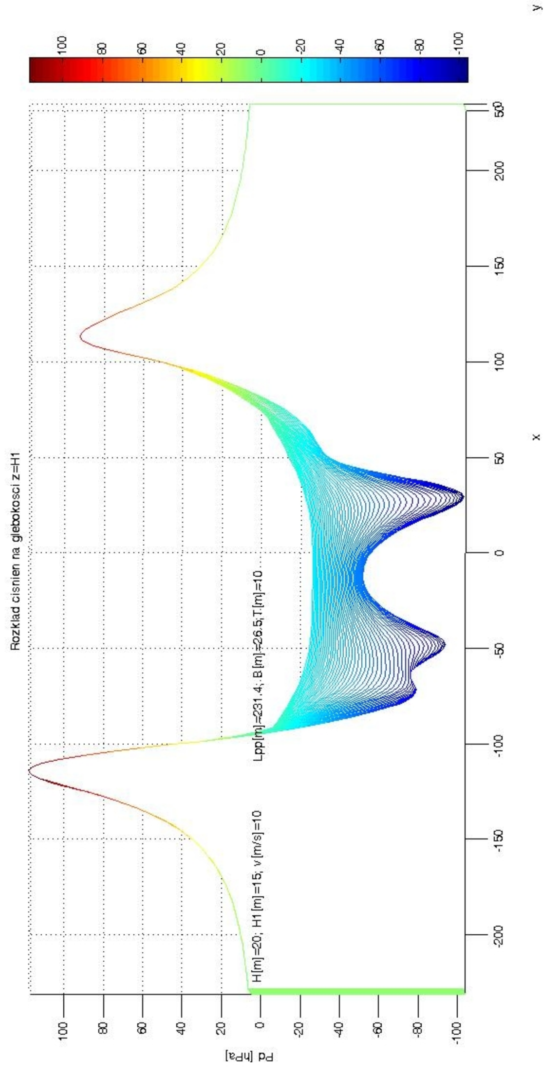

Fig. 5. Intersection vacuum field hydrodynamic in the plane of ship symmetry (SS)

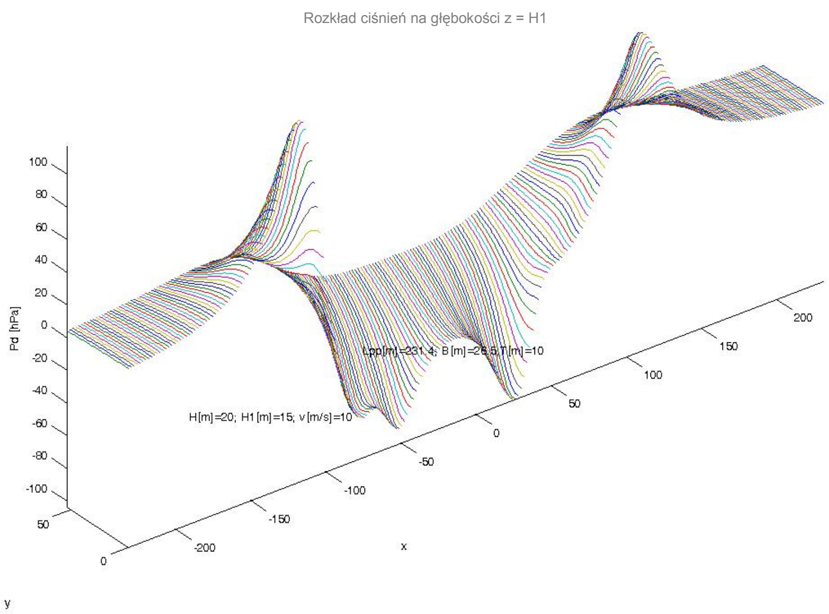

Fig. 6. VFH view showing the exponential decay of the field in the direction y transverse to the SS

Hydrodynamic approximation the vacuum field is shown in the figures below.

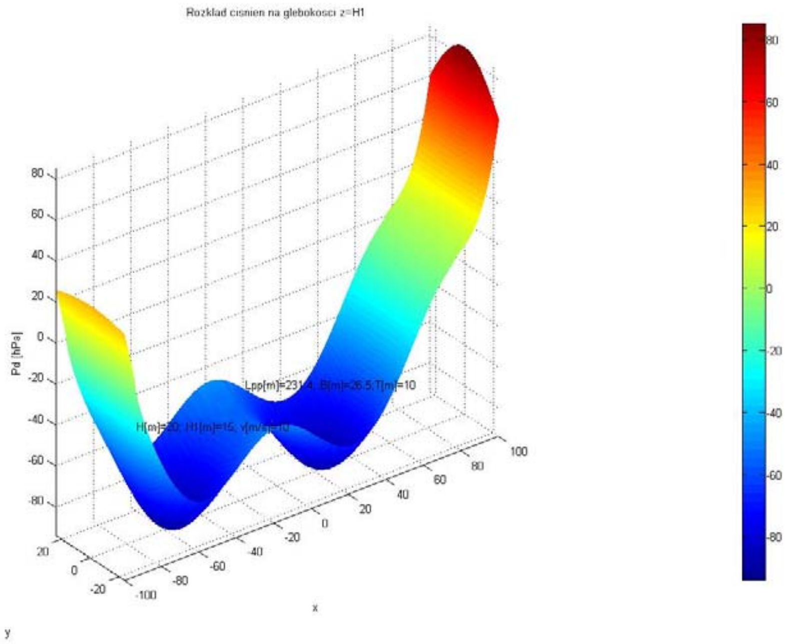

Fig. 7. VFH approximated by using the form (2)

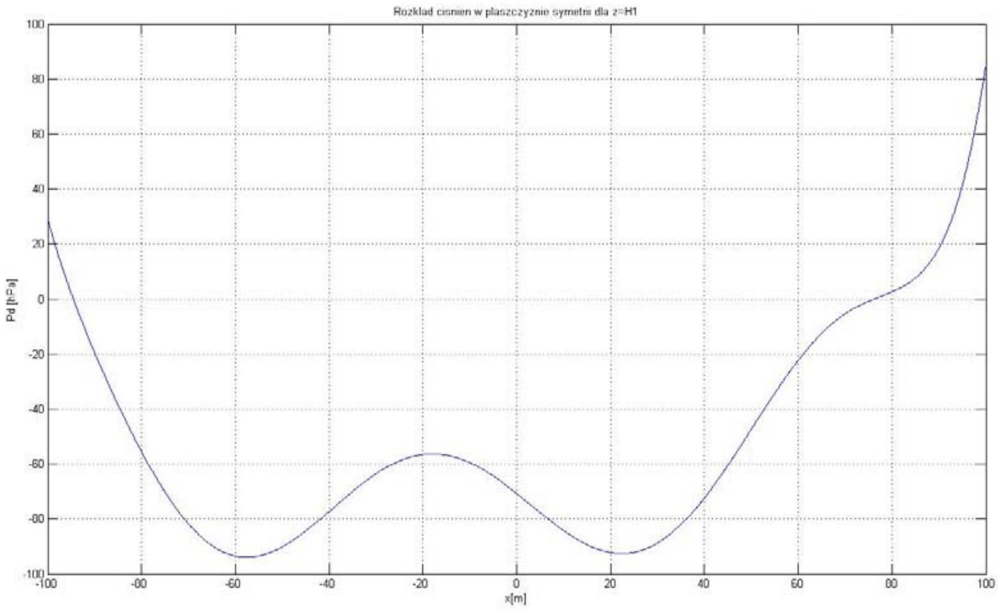

Fig. 8. Cross-section of the vacuum field hydrodynamic in the plane of symmetry of the ship

3. CONCLUSIONS

Based on the results of approximation of the field of ship hydrodynamic vacuum can be concluded that the description of this field using a small number of parameters is characterized by good agreement with the calculations.

Using discovered by calculation of hydrodynamic properties of the field, partially confirmed by tests, it seems possible to describe the hydrodynamic field of the ship with its specific characteristics by using a matrix of numbers with dimensions *MXN*, where $N <= 20$, while M is the row number of levels deep, which must specify the vacuum field hydrodynamic and close to the value of $M <= 10$.

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