The influence of the high-speed Trimaran to Flow Field

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ABSTRACT: Trimaran is of three hull, three slender hull share a main deck and the upper structure, which has many superior qualities, compared with the single ship, aroused people's great interest. In the design of the main concern is to reduce the resistance of trimaran, therefore, to study the effect of convection field trimaran, understand its hydrodynamic performance is very necessary.

INTRODUCTION

Trimaran multibody ship such as compared with the single ship, with wide deck, airworthiness improved, sailing small resistance, stealth performance is good, strong survival ability, such as main characteristics, therefore, is cause the extensive concern of the shipbuilding industry. High-speed transport ships of the sea and in the future military vessels, trimaran has a great development potential.Of trimaran configuration flow field and hydrodynamic research, not only can improve its hydrodynamic performance, and can promote the trimaran is widely used in production and life.

Trimaran design

The basic idea of trimaran project design

Trimaran design is mainly to determine the three body ship hull layout and hull lines and determine its main dimensions, and determine the three elements is designed by considering three body ship's seakeeping, resistance and stability performance results, thus for stability research of trimaran should also have better seakeeping and resistance performance. Trimaran design in this paper to determine before the principal dimensions of first consideration factors are:

(1) the trimaran main body length, body and main body relations, including the length, width, which determine the hull layout.

(2) The determination of three body type line.

The determination of main measure of trimaran

This chapter studies the high speed trimaran multi-body model is Harbin engineering university ship key discipline laboratory of defense Huang Debo professor optimization design. The side of the main body in the model are relatively thin, has good type high speed and good hydrodynamic performance.The main parameters such as table 1.

Table 1. trimaran scale and the related parameters

	Mainbody	Sheetbody
Captain L_0(m)	2.63	1.315
Beam B_0(m)	0.17	0.03
Draft T_0(m)	0.09	0.05

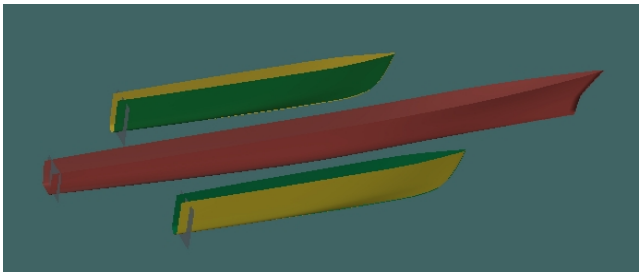


Figure 1. the stereogram of trimaran

Construct a three dimensional model of trimaran

Establish a trimaran model with Prefit

Prefit provides one with the keyboard input current body generate three-dimensional curved surface data. Surface generated by a Prefit can be saved as a Maxsurf design documents. Data type values can also be directly by the text files loaded or copies expanded form. Use Prefit points three steps: lose into fore and aft shape, transverse profile spline fitting, hopson into surface.

Shape of the bow and stern with Prefit

In the process of the first, the shape of the bow and stern to specified by input data values. All values in the same form through figure 2 represented in Maxsurf marked points.

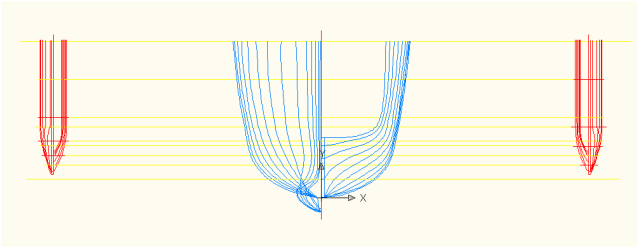


Figure 2. The shape of the bow and stern

(1) According to the coordinate values, entry Prefit, get the main hull, as figure 3.Using Surface inside the tool Generate Surface command to Generate Surface, in the File Save Surface As command to Generate Surface rendering, and then open the edit Maxsruf.

Figure 3. The main hull marked points in Prefit

(2)Synthesis of trimaran complete model with Maxsurf.As shown in figure 4.

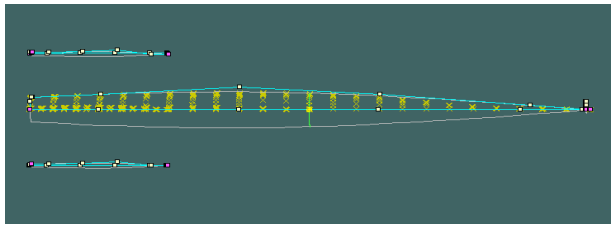


Figure 4. trimaran model

Generate trimaran model, save the Msd suffix files, used for flow field simulation and post-processing in Hullspeed analysis.

The influence of trimaran configuration to flow field

Different configuration design of trimaran

In this chapter,Using the trimaran model for Prototype model. Basic parameters are shown in table 2.1.according to the optimized configuration scheme in the previous chapter, some typical side body layout scheme were studied. Side of the main body of the longitudinal transverse offset p is: 0.3 m, 0.4 m, 0.5 m.Vertical setover a is at the end of the main body: 0 m, 0.15 m, 0.3 m.

Table 2. trimaran strip spacing configuration scheme

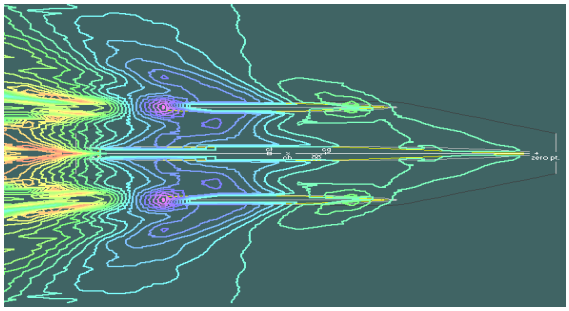
The offset of the lateral side body P/B0	The offset of the longitudinal side body a/L0		
	0	0.15	0.3
0.3	planA1	planB1	planC1
0.4	planA2	planB2	planC2
0.5	planA3	planB3	planC3

Note: A1 for initial body form plan as the side body stern with subject stern flush, lateral offset of 0.3 m.

In the table:Plan A, B and C for fixed side body horizontal layout, change its horizontal layout plan;Plan 1, 2, and 3 for fixed side body vertical layout, change its horizontal layout scheme.

After a period of time, is generated in Hullspeed free page of numerical simulation of wave shape, as shown in the following diagrams.

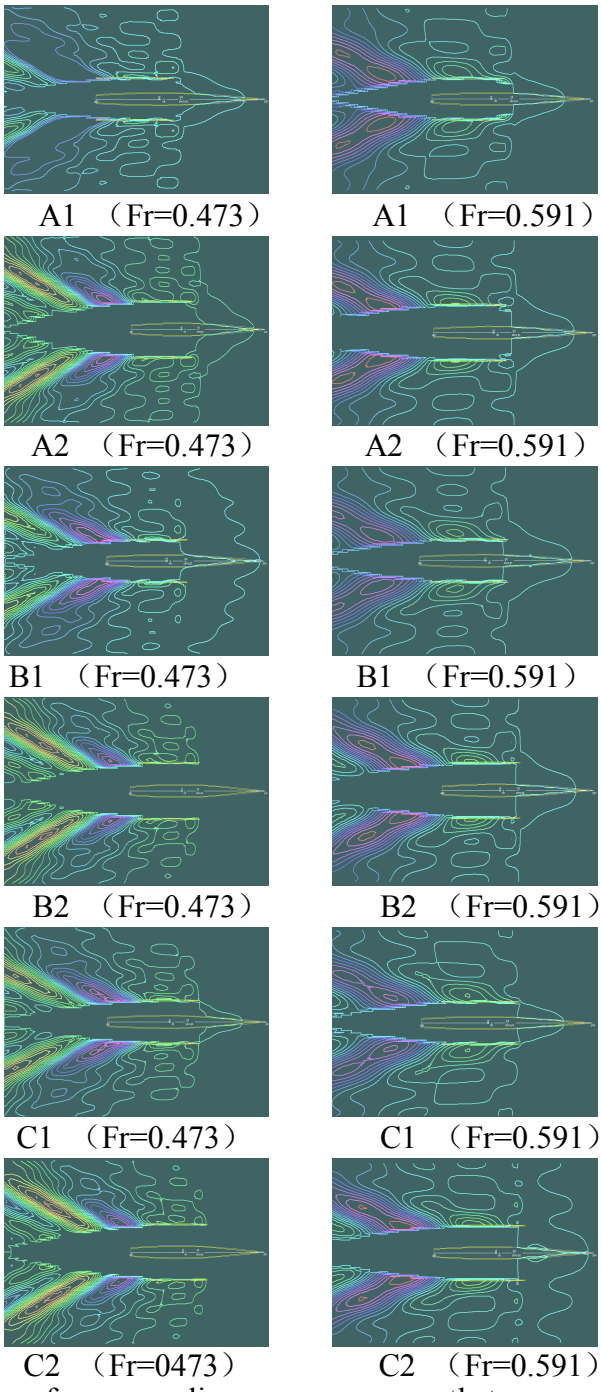
Figure 5. The free pages wave shape



The result comparison of high-speed trimaran ‘s Wave simulation

Free liquid surface wave is one of the important standard to measure the performance of ship form and trimaran is aimed at high speed development of ship type, therefore, in the light of the model is relatively high speed V = 2.4 m/s and V = 3.0 m/s, namely the RuDe number Fr = 0.473 and Fr = 0.591 is analyzed.

Two speed under different side when the layout of the free surface wave as shown in the figure below:



Analysis above the free surface wave diagram, we can see that:

(1)The side body space is small, the three body under different speed has little effect on department of ship bow wave. This is because the three body of ship bow wave is mainly produced by the body, small spacing of side body layout and to its impact is not big.

(2)The side body layout changes, on the trimaran midship section and stern wave to produce a significant effect. And side lateral offset changes impact on the free liquid surface is more than the influence of vertical setover changes dramatically.

(3)The rational allocation of the side of the body layout makes trimaran wave decreases. When the three body side of the ship is decorated in the subject when the first wave troughs trimaran small wave as a whole.

Resistance calculation

Side layout on lateral impact on total resistance coefficient

Fixed side longitudinal position of the body, analysis of lateral spacing on lateral changes of resistance, the influence of A, B and C three kinds of solution being the resistance curve as shown in figure 6, longitudinal resistance coefficient, transverse speed.

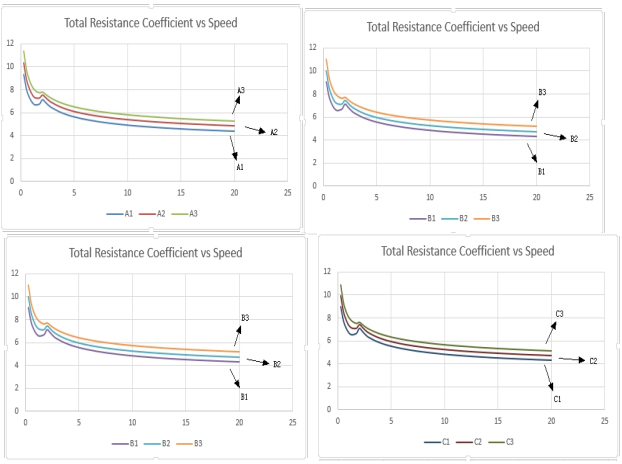


Figure 6. the relationship between the Lateral side body horizontal layout and the resistance

Analysis of the resistance curve can be seen that:

(1)In the above three diagram, each side body body constant longitudinal spacing on the chart, only change the side body horizontal spacing will have great influence on resistance. And low speed trimaran resistance affected by side body horizontal layout more noticeable than high speed.

(2)Within the scope of the study, reasonable arrangement of the side body horizontal spacing will have a good effect on resistance performance of trimaran, the smaller the transverse spacing can be seen from the chart, the total drag coefficient is smaller, but does not rule out the horizontal spacing is too small will bad influences on the total resistance coefficient.

(3)The different speed trimaran side of the corresponding optimal body horizontal layout is different. Low resistance excellent performance of body form plan sometimes bad resistance performance in high speed.

Side layout on longitudinal impact on total resistance coefficient

Similarly, when a fixed three body side longitudinal position of the body, only change the horizontal spacing of resistance curve as shown in figure 7, which is suitable for total resistance coefficient, the longitudinal transverse for speed.

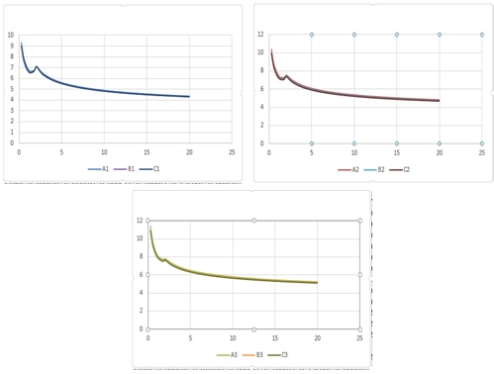


Figure 7. the relationship between the Lateral side body horizontal layout and the resistance

Analysis of the resistance curve can be seen that:

In this experimental results within the scope of trimaran longitudinal layout change effect on the total resistance coefficient and no larger than the horizontal layout change on the influence of the resistance, the change of the longitudinal spacing but have little impact on total resistance coefficient. But the results of these does not preclude Prefit modeling process of omission as well as to the Hullspeed operation error, does not rule out the difference between software itself operation mechanism.

The influence of side body layout of resistance

At the same time change the side body horizontal layout and vertical layout to get the resistance curve as shown in figure 8, which is suitable for total resistance coefficient, the longitudinal transverse for speed.

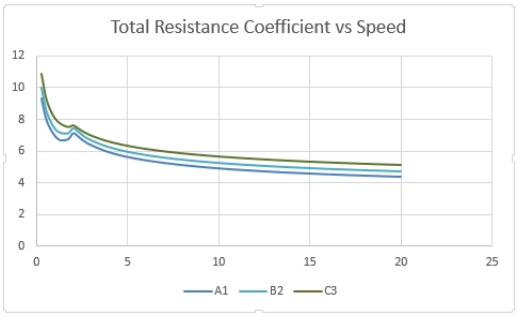


Figure 8. The relation between resistance and layout of side body

Analyze the resistance curve, we can see that:

(1)The three body ship in the same side of the body under the condition of vertical layout, when low speed trimaran frictional resistance coefficient change more obvious than when high speed.

(2)The size of the power curve and speed has a significant positive relationship.

(3)The residual resistance coefficient at low speeds changes twists and turns, when speed gradually increase, the curve flattens.

(4)Although the frictional resistance coefficient and residual resistance coefficient, total resistance coefficient, viscous resistance coefficient and the wave-making resistance coefficient on the part of change with speed tends to smooth, still resistance increased with the increase of velocity.

(5)Viscous resistance coefficient curve and the total resistance curve transition trend consistent, is mainly due to the hull in the water is mainly influenced by the viscous resistance and wave resistance, and high speed trimaran has on wave resistance on lines design is optimized, the viscous resistance of a high proportion of, as a result, the viscous resistance and total resistance curve is higher similarity.

(6)Three body ship wave making resistance coefficient curve in low speed in the active zone, when the speed gradually increase, the wave-making resistance curve has obvious decline phenomenon. This shows tell fine-cut high-speed trimaran to resist interference wave resistance has a better effect.

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