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고속활주선의 운동성능 평가를 위한 수치해석적 추가 연구

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Numerical Additional Study for Evaluate Seakeeping assessment of the Planing Craft

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요 약 : 본 연구에서는 Begovic and Bertorello (2014)의 고속활주선 모델시리즈 중 Warped hull 2의 실험결과를 규칙파 파랑조건을 바탕으로 2가지 기법(스트립 기법 및 CFD)의 수치해석 결과를 비교하였다. 선속의 경우, 총 3가지(3.4m/s, 4.6m/s, 5.75m/s)를 사용하였으며, 속도영역은 반활주 및 활주영역에 해당한다. 결론적으로, 스트립기법의 경우, λ/LOA=2-4 구간에서 공진현상이 발생하여 다른 구간 대비 높은 운동응답 값을 보이는데, 이는 실험값과 상이함을 확인하였다. CFD의 경우, 전반적인 경향은 실험값과 일치하는 것을 확인하였고, λ/LOA=0.5-2.5 구간에서 실험값 대비 다소 큰 운동응답 값을 보였다. 이러한 형상은 속도가 증가할수록 격차가 커지는 것을 확인하였으며, λ/LOA=2.5-5.2에 비해 파고에 배치된 높이방향 격자수가 상대적으로 적기 때문에 오차가 발생한 것으로 판단된다.

핵심용어 : 고속활주선, 운동성능, 운동응답, 스트립 기법, CFD

Abstract : *In this research, experimental seakeeping results of Warped hull form 2 on the regular waves were compared with numerical results of strip method and CFD. In case of ship's speed, there are 3 cases (3.4m/s, 4.6m/s, 5.75m/s) for numerical simulation, and they are belong to semi-planing and planing condition. Consequently, in case of strip method, it is shown that the resonance phenomena occurred from around λ/L_{OA}=2 to 4 and RAO value were significantly higher than that of other. this is different from experimental results. In case of CFD, overall trends were similar with experimental values except there are somewhat excessive RAO values around λ/L_{OA}=0.5 to 2.5. these phenomena is confirmed that it became larger as the ship's speed increased, and it was considered that the error occurred because the number of mesh in vertical direction of wave height at λ/L_{OA}=0.5 to 2.5 were relatively less than those of wave height at λ/L_{OA}=2.5 to 5.2.*

Key words : *Planing Vessel, Seakeeping Performance, Response Amplitude Operator(RAO), Strip Method, CFD*

1. Introduction

As the recent trends have highlighted on evaluation of added resistance of a ship in wave conditions, the researches are concentrated on accurately evaluating the seakeeping performance of a ship in wave conditions, rather than the resistance performance of a ship in calm water. To evaluate them in practically, model tests are the best way for them. However, there are some constraints of time and economic, especially spatial and physical limitations between model and full scale that cause differences in size and flow regime, respectively. In order to overcome these constraints, researches using CFD have been actively conducted. Also, it is expected that full-scale CFD simulations will be actively conducted in the near future. Meanwhile, most of the studies conducted by CFD are focused on the displacement ship, those of small and planing hull are relatively small. Therefore, in this research, in order to secure the reliability of numerical analysis on high speed planing hull, experimental seakeeping results of Warped hull form 2, which were the model series of planing hull developed by Begovic and Bertorello (2012) and based on the regular waves matrix (Begovic and Bertorello, 2014), were compared with numerical results of strip method and CFD. In case of ship's speed, there are 3 cases (3.4m/s, 4.6m/s, 5.75m/s) for numerical simulation, and they are belonging to semi-planing and planing condition which CV values are 1.92, 2.60 and 1.594, respectively.

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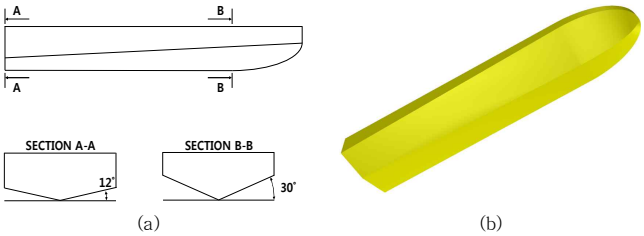
2. Numerical method and model

In this study, numerical method and coordinate system are applied established numerical method of Kim et al. (2017) and added First-Order VOF wave model to give wave conditions. Fig. 1(a) illustrates the conceptual design of model, and length and displacement of the model are 1.9m and 32.73kg, respectively. The geometric views of the model is illustrated in Fig. 1(b).



(a) (b)

Fig. 1 (a) Conceptual design of the warped hull 2, (b) Geometric view of the warped hull 2

3. Simulation and result

Fig. 2-4 shows the heave and pitch RAO values which were conducted by Strip method and CFD. it is indicated that the values of Strip method are different form experimental result because there are some resonance phenomena at λ/LOA= 2 to 4 range. On the other hand, the results of CFD are similar with those of experiment.

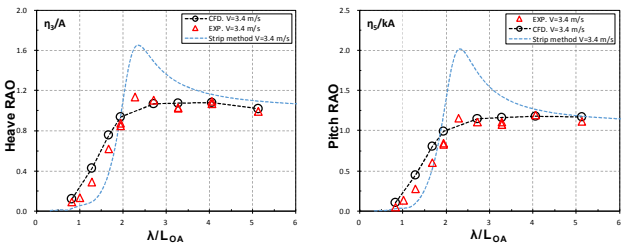


Fig. 2 Comparison of Heave and Pitch RAO / 3.4m/s

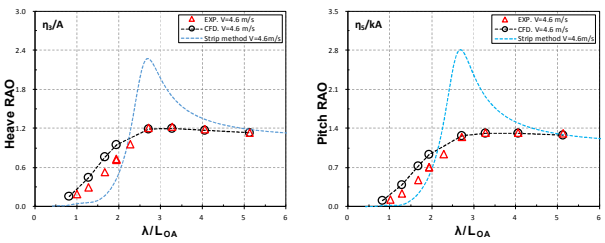


Fig. 3 Comparison of Heave and Pitch RAO / 4.6m/s

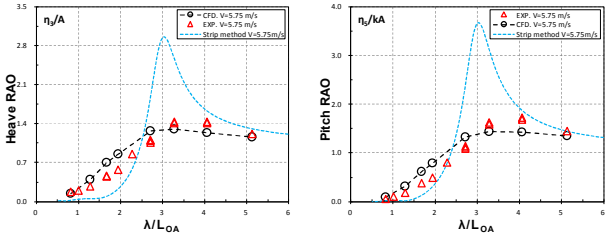


Fig. 4 Comparison of Heave and Pitch RAO / 5.75m/s

4. Conclusion

The main conclusions drawn from the research presented in this paper can be summarized as follows:

1) The results of Strip method showed that it follow in overall tendency, but, in the λ/LOA range from 2 to 4, there are different trend which are resonance phenomena.

2) The results of CFD indicated that it is almost similar with experiments than those of strip method. However, there were somewhat overestimated values which increased the error as the ship's speed increased because the number of mesh in vertical direction of wave height at λ/LOA=0.5 to 2.5 were relatively less than those of wave height at λ /LOA=2.5 to 5.2.

Acknowledgements

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