Streamlined Vessels for Speedboats: Macro Modifications of Shark Skin Design Applications

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Abstract. Functional properties of shark denticles have caught the attention of engineers and scientist today due to the hydrodynamic effects of its skin surface roughness. The skin of a fast swimming shark reveals riblet structures that help to reduce skin friction drag, shear stresses, making its movement to be more efficient and faster. Inspired by the structure of the shark skin denticles, our team has conducted a study on alternative on improving the hydrodynamic design of marine vessels by applying the simplified version of shark skin skin denticles on the surface hull of the vessels. Models used for this study are constructed and computational fluid dynamic (CFD) simulations are then carried out to predict the effectiveness of the hydrodynamic effects of the biomimetic shark skins on those models. Interestingly, the numerical calculated results obtained shows that the presence of biomimetic shark skin implemented on the vessels give improvements in the maximum speed as well as reducing the drag force experience by the vessels. The pattern of the wave generated post cruising area behind the vessels can also be observed to reduce the wakes and eddies. Theoretically, reduction of drag force provides a more efficient vessel with a better cruising speed. To further improve on this study, the authors are now actively arranging an experimental procedure in order to verify the numerical results obtained by CFD. The experimental test will be carried out using an 8 metre flow channel provided by University Malaysia Sarawak, Malaysia.

INTRODUCTION

Shipping trade can be deliberately described as a rapidly grown industry. It has developed into a wide-ranging economy each year and the size of most vessels have even revolutionized unexpectedly [1]. Numberless studies have been carried out by researchers today that focuses on shipbuilding considering on modification of hull designs, optimizations and application of effective-boosting features which help to improve and enhance the efficiency of these vessels especially during manoeuvring. The investigation on hull includes the study of vessel's motion which can be classified as a challenging fluid mechanics problem. With rapid growth of technologies such as powerful computers and advanced soft wares, studies include numerical simulations using computational fluid dynamic (CFD) which uses numerical analysis and data constructions is more preferable in order to have an early study in solving and examining problems related to fluid flow. Nowadays, CFD are widely used as an alternative to evaluate the flow properties as well as solving to numerous engineering problems especially in systems and operations. However, further study like experimental test is crucial to be conducted in order to validate the numerical results obtain using CFD soft wares [2-4]. Relating to the development of vessels today with the help of technology like CFD, the hydrodynamic effect and wave resistance can be predicted through study of free surface flow around vessel or ship.

Our main focus in this study is on hull design by doing macro modification of biomimetic shark skin denticle as an alternative to come up with a more streamlined vessel. However, in this present paper, we described our approach by focusing on wave elevation and hydrodynamic effect of vessel with and without modification of biomimetic shark skin through CFD activity. Imitating or adapting nature like shark skin as a drag reduction mechanism is a technique

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