Hydrodynamics of the interceptor on a 2-D flat plate by CFD and experiments*

MANSOORI M.1, FERNANDES A. C.2
1. Department of Naval and Ocean Engineering, Federal University of Rio de Janeiro, RJ, Brazil, E-mail: mkerend2004@gmail.com
2. Department of Naval and Ocean Engineering, Federal University of Rio de Janeiro, RJ, Brazil

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Abstract: Nowadays, the use of interceptor by both partial and total dynamic lift crafts is quite common. In this article, a lot of evidence is given regarding the effectiveness of interceptor. The interceptor, when placed at the stern region, changes the pressure distribution around the craft. Its presence affects drag force, lifting force and the position of pressure’s center leading to a new trim. This study focuses on hydrodynamic effects of interceptors on a 2-D flat plate based on both computational fluid dynamic (CFD) and experimental approaches. The Reynolds average Navier-Stokes (RANS) equations are used to model the flow around a fixed flat plate with an interceptor at different heights and attack angles. Based on finite volume method and SIMPLE algorithm which uses static structures, this model can be analyzed and the RANS results can be compared with the experimental data obtained in the current channel of the laboratory of waves and current of COPPE/UFRJ (LOC in Portuguese acronym). According to the results, the increase of pressure at the end of the flat plate was proportional to the interceptor height. In addition, the existence of interceptors can significantly increase the lift force coefficient at high angles of attack also proportional to the interceptor height. The presence of interceptor at the end of the flat plate increased both the lift coefficient and the drag coefficient but hydrodynamic drag did not grow as fast as the lift coefficient did. The lift coefficient increased much more. Furthermore, the results showed that the interceptor effectiveness is proportional to the boundary layer thickness at the end of the flat plate. As the interceptor was inside the boundary layer alterations of flow speed led to changes in boundary layer thickness, directly affecting interceptor’s efficiency. Optimum choice of interceptor height had a great effect on its efficiency, and in choosing it the flow speed and length of the boat must be taken into consideration.

Key words: interceptor, craft, 2-D flat plate, lifting coefficient, Reynolds average Navier-Stokes (RANS), pressure distribution, computational fluid dynamic, drag

Introduction

The interceptor is composed of a thin vertical plate usually perpendicular to the craft hull and located near the stern. The major role of the interceptor is to apply an overpressure enough to lift the stern, which leads to change of the craft’s trim. Figure 1 shows the outline of an interceptor implementation at the aft of a planing craft.

The dynamic instabilities like progressive heeling, trimming, and chine walking, unstable pitching and rolling-induced parametrically[1,2] may show up. The occurrence of proposing instabilities is also possible[3]. Nevertheless, due to presence of the interceptor, the pressure distribution, which is changed by the craft movement, leads to the variation of draft, trim and possibly the control of the mentioned instabilities. Traditionally, the trim control tools are located at the stern.

* Biography: MANSOORI M. (1984-), Male, Ph. D., Postdoctoral Researcher