Design and Cavitation Performance
of Contra-Rotating Propellers

by

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Abstract

Improvement of the propulsive efficiency of ships has always been one of the main objectives for naval architects and marine engineers. Contra-Rotating propellers (CRP) are propulsor configurations offering higher efficiency compared to conventional single propellers by recovering the rotational energy in the propeller slipstream. The application of this type of propulsive device to modern ships becomes even more attractive, considering the recent developments in electric propulsion and the increased emphasis on fuel economy. Propeller design codes are therefore expected to include CRP design capabilities.

This thesis describes two methods for designing CRP in the context of lifting-line theory, along with a procedure for predicting the cavitation performance of conventional propellers and CRP. All of the above methods have been implemented numerically and integrated into a computer program developed in MATLAB®.

Comparisons of numerical predictions of efficiency between single and contra-rotating propellers, which confirm the superiority of the latter are presented. Physical insight into the increased efficiency of CRP is also obtained by presenting results for the velocity fields induced by these propulsor configurations. In addition, the predicted cavitation patterns, observed on conventional and contra-rotating propellers operating in uniform and non-uniform wakes, show the advantage of CRP with respect to the occurrence of cavitation.

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