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Experimental Analysis of Cavitation Erosion on Blade Root of Variable Pitch Propeller

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The aim of this study is to experimentally investigate the cavitation erosion on the blade root of four blade controllable pitch propeller. Experiments are carried out on a model scale propeller considering two different pitch settings of propeller. The soft paint technique is used to study cavitation erosion, exploiting also two standard cameras and one high speed camera to study the damage patterns and cavitation dynamics, respectively. Standard cameras are placed on the top of test section in order to periodically monitor the occurrence of damages on the layer of paint. The high-speed camera has been used instead to analyse bubble dynamics and identify potentially erosive phenomena. Different camera configurations have been considered to get detailed insights of bubble dynamics on pressure and suction side of propeller blades. The paint tests results have been analysed together with high-speed videos, showing a remarkable agreement between the occurrence of damage and cavitation collapse phenomena. The results demonstrated three regions on the propeller blade with high risk of erosion: (1) suction side of blades, around mid-span, showed pitting damages due to sheet cavitation collapse, (2) suction side blade root showed significant damage pattern due to single bubble as well as bubble assembly collapse, and (3) pressure side blade root showed slight damage pattern due to spherical bubble collapse. In addition, four different cavitation bubble structures have been identified in the present study: sheet cavitation, streak cavitation, spherical bubble cavitation, and twisting bubble cavitation.

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