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Calculation of Steady Cavitation on a Marine Propeller Using a Simple Surface Panel Method

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Summary: This paper presents a calculation method for the steady cavitating propeller problem. The method is based on a simplified surface panel method "SQCM" which satisfies the Kutta condition at a time even for the 3-D problem. Hess and Smith type source panels are distributed on the propeller and cavity surface. Discrete vortices are distributed on the camber surface according to Lan's QCM (Quasi-Continuous vortex lattice Method). The boundary conditions to determine these singularities are the constant pressure condition on the cavity surface and the zero normal velocity condition on the propeller and camber surfaces. The cavity shape in each radial section is determined so that the zero normal velocity condition are satisfied. In the present method, a cavity length for each radial section is given first. Then the singularities and the cavity shapes are determined. These steps are repeated until both constant pressure condition and normal velocity condition are satisfied on the cavity surface. Next, the cavity length is corrected in order that the opening at the cavity end will get closer to the target value. By using the corrected cavity length, the calculation is repeated from the beginning. These steps are repeated until the opening at the cavity end agrees with the target value in each section. In this method, constant pressure condition is satisfied including cross flow velocity because its effect is not small near the tip of a propeller blade. Cavity pattern, shapes, pressure distributions and forces acting on propellers are calculated for two kinds of propellers. Good agreements are obtained between the calculated results and the experimental data.

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