HYDRODYNAMIC IMPACT INSIDE CYLINDRICAL CAVITY

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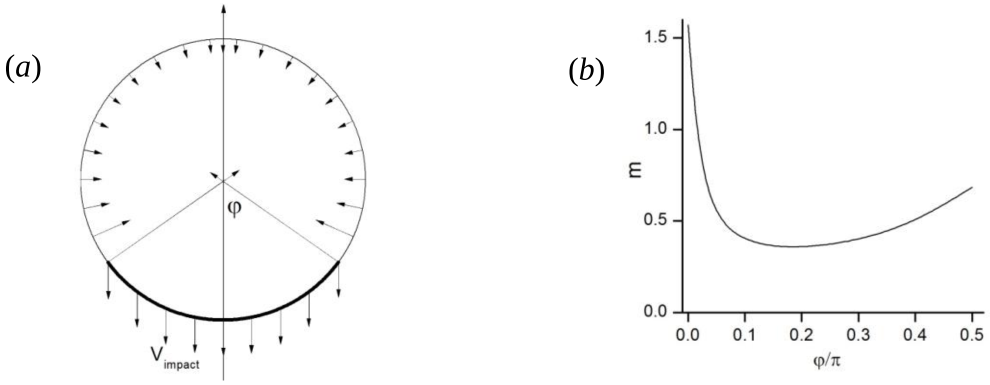
ABSTRACT

Underwater vehicles that travel inside a supercavity require much less energy consumption than that which surface completely in contact with the liquid . This occurs due to the reduction of the contact area and the drag consequently when the supercavity is established. At the same time this type of motion faces some challenges to control the stability of the motion. Experimental studies of supercavitating models moving at speeds in the range from 400 m/s to 1000 m/s, carried out at IHM, revealed a regime of ricochet movement, in which the rear part of the axisymmetric model periodically ricochetizes on the boundaries of the supercavity. The interaction between the model and the cavity boundaries in the ricochet movements is similar to water impacts. It is shown that the impact loads can lead to loss of the stability of the supercavitation motion and the structural stability of the model. In order to study this process, we consider the problem of impact between the circular arc body and the cylindrical cavity. The primary interest of the study is to investigate the effects of the cavity and body shapes on the added mass and velocity distribution along the cavity surface just after the impact. The impulsive motion of impact of the arc shaped body is studied within the velocity potential theory The liquid is assumed to be ideal and incompressible, and the flow is irrotational. The thick solid line in figure (*a*) corresponds to the body, the cavity free surface is shown by the thin line. The velocity distribution shown in figure has been computed for the angle $\varphi = 0.3\pi$. The integral hodograph method is used to derive governing equations for the complex velocity and for the derivative of the complex potential both defined in an auxiliary parameter plane. From these equations the function mapping the auxiliary parameter plane onto the physical plane is obtained. The problem is reduced to a system of two integro-differential equations respect to the unknowns velocity magnitude on the free surface and angle between the velocity vector and the cavity surface. These equations are solved numerically using the method of successive approximations. The problem of impact of the plate onto the flat free surface is obtained as a specific case when the radius of the cavity tends to infinity.



(a) Velocity along the cylindrical cavity generated by the impulsive motion of the circular arc, and (b) the added mass coefficient vs. the angle of the circular arc.