Numerical Simulation and Experimental Measurement of Supercavitating Flow around a Highspeed Moving Object in Water

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Abstract: Supercavitating flow is generated around a submerged object in water when the relative velocity between the object and water exceeds some particular value. Such value depends on the shape of the cavitator and local flow conditions, e.g. fluids properties, temperature, the depth of the object etc. In such case, the pressure around the object drops below the saturation pressure of water at the liquid temperature. Vapor is generated to form a supercavity surround the object.

Supercavitation phenomenon is usually encountered in environment or in underwater applications in various areas of industry and engineering. Supercavitation can be very useful for reducing drag around the object. That is one of the key methods to control the highspeed moving object under water. Consequently, results of research on this phenomenon is very useful for designing or controlling highspeed moving objects in water.

In supercavitating flow, the shape of the cavitator (i.e. the wetted nose or the fore-body of the object) is one of the important control parameters. In order to characterize the effects the cavitator shape on the flow dynamics, numerical model has been developed for the simulation of supercavitating flow around an axis-symmetric cylindrical body with various cavitators shapes. Simulations have been carried out using advanced Ansys Fluent numerical code. On the other hand, a laboratory-scale experimental model has been developed for the measurement of supercavitating flow. Optical observation using highspeed camera has been exploited.

Numerical models have been validated using experimental measured data. As a result, numerical simulations have been carried out to study the effects of different cavitators shapes on supercavitating flow dynamics. This study should be of highly considerable interest to designers and engineers in the related field of manufacturing and controlling of highspeed traveling objects in water.

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