

COLLOQUIUM

Group: Engineering Fluid Dynamics

As part of his MSc thesis assignment

W.R. Brouwer

will give a presentation, entitled:

Designing an Experiment to Validate the Attenuating Effect of Air bubbles on Pressure Fluctuations in a Depressurized Environment

Date: Friday June 5, 2015

Time: 14:00

Room: Horst Building Room N-109

Summary:

As part of the hydrodynamic research performed on a ship, MARIN conducts experiments using scaled models in large towing tanks. To assess the risk of vibrations, the propeller-induced hull pressure fluctuations are measured in a depressurized towing tank. In the reproduction of these measurements, differences up to 25% in pressure amplitude are found. A possible cause of the poor reproducibility of these measurements is a variation in the concentration of air bubbles between the propeller and the hull.

From a theoretical model by Commander and Prosperetti it follows that for low ambient pressures, large air bubbles have an attenuating effect on low frequency pressure fluctuations. Using this model, the following hypothesis has been formulated:

Bubbles with diameters of 7-37 mm will attenuate sound starting from frequencies of 250-50 Hz, respectively, for an ambient pressure of 8,000 Pa, according to the model of Commander and Prosperetti.

This model has not been validated experimentally for large bubbles at such low pressures. To validate this model and to test the proposed hypothesis, an experiment has been designed. It consists of a sound source, a bubble screen and a receiver. For the generation of sound a transmitting hydrophone has been chosen, capable of producing sound waves of frequencies as low as 50 Hz, which were measured by a receiving hydrophone.

The generation of a bubble screen has been investigated experimentally in a small depressurized tank. Multiple hollow needles of various sizes were used, in combination with pressurized nitrogen and several mass flow controllers. High speed video cameras have been used to observe and measure the diameter of the bubbles in the experiments, giving a measurement uncertainty of approximately 1 mm. Using needle diameters from 0.51 to 1.54 mm and flow rates of 0.07 to 0.45 l/min, bubbles were generated with diameters ranging from 5–25 mm. It was found impossible to control the number of bubbles leaving a needle per second, without changing the size of the exiting bubbles.

The final experiment took place in the Depressurized Wave Basin at MARIN, combining the above components in a single setup. During the experiment a defect occurred, terminating the experiment prematurely. Therefore, at this moment no results with regard to the hypothesis can be given. The result of this study is the design of an experimental setup, usable for testing the hypothesis formulated above.

Assessment committee:

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d.d. _____