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Scaling properties of the Ffowcs-Williams and Hawkings equation for complex acoustic source close to a free-surface MARTA CIANFERRA, VINCENZO ARMENIO, Univ of Trieste - Trieste — We investigate sources of discrepancy arising when using the acoustic results obtained at model scale, to deduce the acoustic field at full scale. Two aspects are pointed out: the classical similarity principle between a model and a prototype and the effects of a free-surface on the reflection of the acoustic signal. The analysis is carried out taking advantage of the Ffowcs-Williams and Hawkings equation. The free-surface is considered as a smooth plane, taking advantage of the method of images, thus considering the half-space Green function. As a test case we consider an open-sea ship propeller, tested in pulling condition at a model scale in the limit of Fn=0. The fluid dynamic data were obtained in a previous work, through the use of a Large-Eddy simulation. As a main result, application of similarity theory shows that perfect similarity can be obtained if the speed of sound at the laboratory scale is properly scaled. Overall, results show that imperfect similarity and absence of a free-surface in model tests, introduce errors when rescaling the model test data to full scale. In other words, acoustic data obtained at the model scale may be not significant for the acoustic characterization of the full scale propeller. In particular, the error becomes not negligible in the far field, where the quadrupole acoustic field, associated to the wake, predominates and noise spectrum may be substantially modified. The study may be considered of general importance and may be applied to a wide range of problems in hydroacoustics.

Marta Cianferra
Univ of Trieste - Trieste

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