XI International Conference on Computational Methods in Marine Engineering

Numerical Modelling of Underwater Radiated Noise from Rigid and Flexible Foils

Magnus Vartdal[1] and Carl Erik Wasberg[1,*]

[1] FFI (Norwegian Defence Research Establishment)
P.O.Box 25, N-2027 Kjeller, Norway.

[*] carl-erik.wasberg@ffi.no

ABSTRACT

In the absence of cavitation, underwater radiated noise from propellers and control surfaces can have significant contributions from a variety of sources, such as tip vortices, trailing edge noise and other fluid dynamic phenomena. Furthermore, the flow will, in general, cause the structure to vibrate inducing vibro-acoustic effects, such as propeller singing, that can be the dominant source of noise. If the structure is sufficiently flexible, steady deformations can also affect the flow field in a manner that changes the noise profile.

The present work consists of numerical simulations of flow in non-cavitating conditions, evaluating the far-field noise using the acoustic analogy of Ffowcs Williams-Hawkings for arbitrary surfaces (Brentner and Farassat, 1998). As a simplification of the rotating propeller problem, we consider a foil based on a cross-section profile of a submarine-type propeller blade, mounted at the root on a wall. The foil geometry is shown in Figure 1.

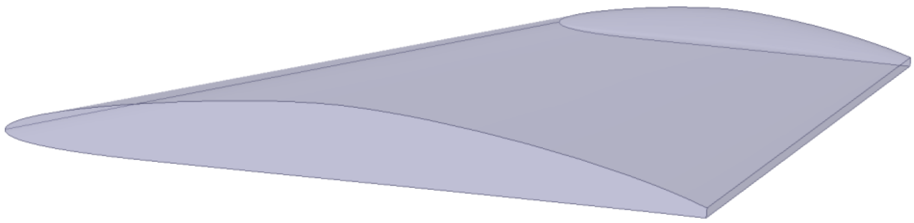

Figure 1: The foil as seen from the root. Flow from left to right.

The aim is to isolate different sources of noise and investigate corresponding modelling strategies. To this end, we consider configurations involving rigid, steadily deformed, and dynamically responding foils. The latter is not commonly done in the marine setting but an example of such a study is found in Chevalier et al, 2019. In order to isolate sources of noise for a given configuration, we vary the turbulence model (URANS and LES) and the surface used to evaluate the source terms for the acoustic analogy.

References

K. S. Brentner, F. Farassat. An analytical comparison of the acoustic analogy and Kirchoff formulation for moving surfaces. AIAA journal 36(8),1379-1386, 1998.

F. Chevalier, L. Bordier, C. Leblond, F. Sainclair, J.-M. Sanchez, G. Serre. Numerical prediction of non-cavitation noise from marine propeller, Undersea Defence Technology, 2019.