Plugging the knowledge gap

Surface ship radiated flow noise project completed

Advances in weapon and sensor capabilities are driving an increased interest in the control of underwater signatures of naval platforms.

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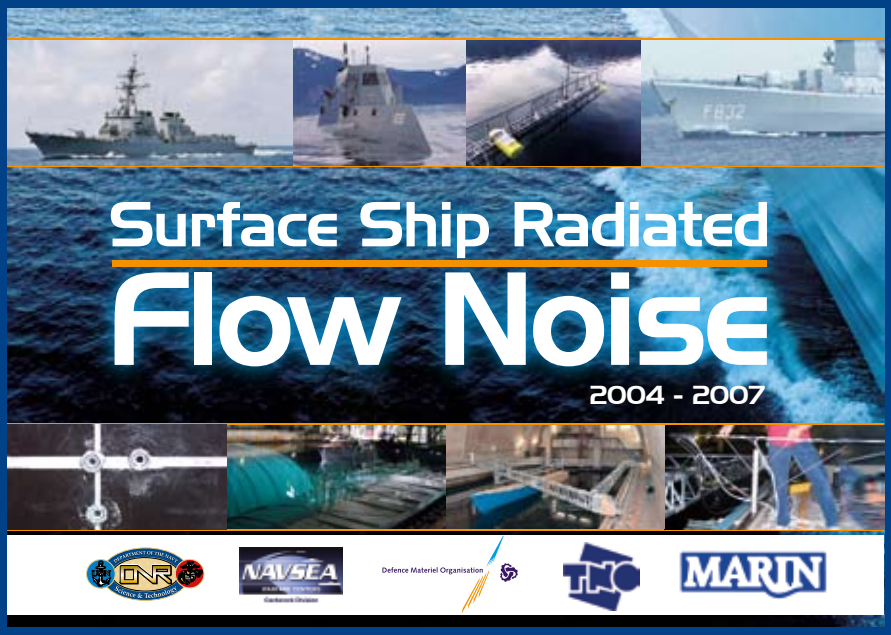

The control of machinery and propeller noise mechanisms is well understood but there is a shortfall of knowledge into the mechanisms that govern noise due to the flow around the hull. A recently completed project investigates the issue.

A collaborative effort between the Naval Surface Warfare Center, Carderock Division (NSWCCD) in the US, Dutch research institute TNO and MARIN, led to the Mechanisms and Prediction of Surface Ship Radiated Flow Noise project, that was started in 2004 and finished this year. Funding was provided by the Office of Naval Research (ONR) in the US and the Dutch Ministry of Defence.

The project aimed to determine and quantify the sources of flow noise generated by surface ships, in terms of ship speed and hull shape. An extensive range of model-scale, large-scale (Advanced Electric Ship Demonstrator AESD) and full-scale (M-frigate, DDG-51 Class) tests were conducted and these included evaluations of flow noise performance for both conventional and tumblehome hull forms. Complementary computational fluid dynamics analyses were performed for both hull types. Based on initial assessments, it was decided that the primary focus would be on developing prediction capabilities for underwater noise generated by turbulence excited hull plating vibration and noise resulting from breaking bow waves.

Small-scale tow tank studies were made in the US and the Netherlands on both hull forms. To discriminate the bow wave flow noise from background noise a special silent towing carriage was developed by MARIN and an acoustic array was developed by TNO. The hulls were equipped with pressure transducers to measure the turbulent boundary layer pressure fluctuations. All measurements were successfully performed with acceptable signal to noise ratios and these proved that the special towing carriage was indeed very silent.

The range of tests at different scales contributed to the understanding of the two flow noise mechanisms, the development of scaling laws and, in combination with CFD-results, to the development of theoretical models for both hull forms.