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Self noise in underwater acoustic sensors

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Abstract

Detection capability of an underwater acoustic system depends on the minimum signal level the acoustic receiver can detect in the presence of various noise sources. The Minimum Detection Level (*MDL*) must be lower than the strength of the acoustic signal that is to be detected. A low value of *MDL* of the receiver system ensures long range detection and is associated with increasing the Signal-to-Noise Ratio (*SNR*). The *SNR* is generally increased by minimising the self-noise of the receiver.

An underwater acoustic receiver consists of hydrophones, preamplifiers and subsequent signal processing electronics. The hydrophones and the electronic components in the preamplifiers generate self-noise due to the fundamental physical phenomenon of molecular agitation at temperatures above absolute zero. The self-noise in the hydrophone is amplified by the preamplifier and further gets added with the self-noise of the preamplifier circuits, whereas the signal level remains the same. This process gradually degrades the *SNR* as the signal passes through the signal chain and ultimately sets the lowest detectable limit of the receiver system. Therefore, it is important to determine the self-noise of the acoustic sensors and the preamplifiers and optimise their combination to minimise the degradation in SNR and maximise the detection capability of an underwater acoustic system.

A quantitative analysis on the self-noise characteristics of hydrophones and preamplifiers, the method of determining these noises experimentally and a means of optimising the hydrophone-preamplifier combination to enhance the performance of an underwater acoustic system will be presented in the lecture. This study would be useful to enhance the performance of various underwater acoustic systems employed, for example, in oceanographic, naval and commercial applications designed for ambient sea noise measurement, acoustic surveillance and fish- finding, respectively.