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Array gain degradation due to nearby bubbles

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Signal-to-noise ratio (SNR) is signal power divided by noise power, usually expressed in dB ($\text{SNR} = 20 \cdot \log_{10}(P_{\text{sig}}/P_{\text{noise}})$)

Array gain (AG) is the increase in SNR at an array output relative to that at a single element. AG assumes spatially-compact signals embedded in spatially-diffuse noise or interference.

When the array is steered in the direction of a signal, AG is maximum when the signal is fully coherent across the array (i.e. the signals add in phase for all elements) while the noise or interference is incoherent across the array (i.e. adds with random phase).

For an acoustic array operating in the ocean, we would like to understand the degree to which nearby bubbles degrade AG. Scattering by bubbles represents interference at the array. Bubble attenuation can also degrade array performance by attenuating the signal of interest, but that is separate from AG degradation.

Previously we applied the single scattering approximation of Ishimaru (1977, Chap. 6) and found that scattering from bubbles very close to the array can generate correlated interference, thereby decreasing AG. Here we validate the theory using in-water measurements of AG as the distance of from the array to the bubbles varies.

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