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Calibration of broadband active acoustic systems using a single standard spherical target

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When calibrating a broadband active acoustic system with a single standard target such as a sphere, the inherent resonances associated with the scattering by the sphere pose a significant challenge. In this research, a method is developed which completely eliminates the source of resonances through isolating and exploiting the echo from the front interface of a sphere. This echo is relatively insensitive to frequency over a wide range of frequencies, lacking resonances, and relatively insensitive to small changes in material properties and, in the case of spherical shells, shell thickness. The research builds upon the concept of using this echo for calibration in the work of Dragonette et al. (J. Acoust. Soc. Am. 69, 1186-1189 (1981)). This current work generalizes that of Dragonette by 1) incorporating a pulse compression technique to significantly improve the ability to resolve the echo, and 2) rigorously accounting for the scattering physics of the echo so that the technique is applicable over a wide range of frequencies and material properties of the sphere. The utility of the new approach is illustrated through application to data collected at sea with an air-filled aluminum spherical shell and long broadband chirp signals (30-105 kHz).