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Acoustic scattering by deformed elongated objects: bent or rough finite cylinders, bent edges, and other stuff

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Predicting acoustic scattering by deformed elongated objects remains a challenge as there are no exact analytical solutions. Numerical solutions are also challenged through various computational issues. In this research, we have developed and applied an approximate analytical approach for predicting scattering by various deformed elongated objects, including bent or rough finite cylinders and deformed edges. The formulation is based on a line integral in which the scattering or diffraction per unit length of the exact solution to an infinitely long, straight undeformed object is integrated along the length of the finite-length deformed object, accounting for variations along the length of phase and certain local properties of the object. Predictions concerning various types of deformed finite cylinders are first discussed (including Stanton, J. Acoust. Soc. Am. 86, 691-705 (1989) and subsequent papers), followed by recent predictions concerning deformed finite edges (Stanton et al., J. Acoust. Soc. Am. 122, 3167-3176 (2007)). These latter predictions using the approximate line integral compare favorably with predictions based on the T-matrix numerical method, which is formally exact. Also discussed are: dependences upon length, orientation, bend, and roughness; comparisons with experimental data concerning machined objects and marine life; and range of validity of the approach.