Numerical simulations comparing nonlinear acoustic effects in straight and tapered tubes – Brian C. Tuttle and Victor W. Sparrow

In their efforts to improve the efficiency of an orifice pulse tube refrigerator, Olson and Swift [Cryogenics **37** (12) 769–776 (1997)] reported on the benefit of using an optimal taper angle in the construction of the conical pulse tube. They concluded that this geometry effectively suppressed nonlinear acoustic streaming which was interfering with the desired heat transfer within the device. To investigate further the effects of tube geometry on streaming, a numerical simulation is developed for a tube with varying degrees of taper angle. This 2-D finite difference model, based on the work of Sparrow and Raspet [J. Acoust. Soc. Am. **90** (5) 2683-2691 (1991)], compares nonlinear acoustic propagation in a straight cylindrical tube with that in a tapered conical tube. Development of the model equations in cylindrical and spherical coordinates as well as refinement of the computational grid near the boundaries are considered. [Work supported in part by the Office of Naval Research]

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