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Numerical model of boundary layer effects in Rayleigh streaming

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In thermoacoustic devices such as the pulse-tube refrigerator, efficiency is diminished by the formation of a second-order mean velocity known as Rayleigh streaming. This flow emerges from the interaction of the working gas with the wall of the tube in a thin boundary layer. This research develops a numerical model to investigate Rayleigh streaming in straight and tapered tubes. Since the accuracy of the model depends on the correct representation of boundary layer effects, special consideration is given to the computation of thermal and viscous boundary layers including finite difference methods, computational grid refinement, and exaggeration of physical parameters for testing of boundary layers at low grid resolution. The model also allows for the inclusion or exclusion of temperature-dependent viscosity and thermal conductivity terms, the effects of which will be examined. [Work supported in part by the Office of Naval Research.]