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Asymptotic Solutions for Resonant Acoustic Oscillations in Cylindrical and Spherical Geometries

The propagation of acoustic waves in closed containers provides a natural context in which to study the mechanisms of shock formation and their dependence upon underlying geometry. As is well known, for the case of a gas in a straight tube with a closed end, shocks form and all harmonics are generated, see Chester (JFM 1964). Recent studies have shown that in more general axisymmetric geometries the flow can be continuous or shocked depending on the input Mach number and the details of the geometric configuration. A nonlinear geometric acoustics approach is used to analyse the shocked motion of the gas and provide an approximation with respect to a geometric parameter associated with the ratio of the inner radius to gap width. Based on comparisons with full numerical solutions it is seen that the approximation remains valid for a surprisingly wide parameter regime. This provides insight into the nature of the interplay between geometric and nonlinear effects and in particular the transition between shocked and continuous flows. The effect of density variation will also be discussed. This is joint work with Brian R. Seymour(UBC) and Michael P. Mortell (UC Cork).