An Operatorial Method for the Calculation of the Acoustic Field in a Shape Perturbed Resonator

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Acoustic resonators have recently found favor as instruments used in the determination of thermophysical properties of dilute gases and primary thermometry applications. Due to their extremely high precision, the final achievable accuracy would profit by an enhanced reliable characterization of the most common perturbative effects which are caused by practical limits encountered in their design and realization. Although the coupling effects between the gas and the inner surface of a perfect spherical resonator are well known [1], a general method for the determination of the perturbed eigenstates of the acoustic field within a resonant cavity is worth a closer examination. We illustrate a mathematical method suitable for this purpose, which is based on classical lagrangian field theory. In principle, this method allows for the determination of the eigenstates of the physical system of interest with arbitrary precision. The method was applied to the calculation of the perturbed eiegenstates and eigenvalues of the resonant acoustic field confined in a spherical geometry caused by different types of geometrical imperfections. We compare our results to those previously obtained using classical perturbation theory [2, 3]. The prospects of an application of the method to the calculation of similar perturbative effects on a vectorial electromagnetic field are also briefly discussed.

[1] J.W.S. Rayleigh, Theory of Sound, 1896, reprinted by Dover, New York, 1945
[2] J.B. Mehl, *J. Acoust. Soc. Am.* **71**, 1109 (1982).
[3] J.B. Mehl, *J. Acoust. Soc. Am.* **78**, 782 (1985).