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Signal processing of impedance spectrum for speed of sound and pressure measurement in plane or radial resonators

Eric Rosenkrantz[a], Jean-Yves Ferrandis[a] and Gerard Leveque[b]

[a]Institut d'Electronique du Sud UMR-CNRS 5214, Université Montpellier 2 CC082, Place Eugène Bataillon, 34095 Montpellier, France

[b]Institut d'Electronique du Sud UMR-CNRS 5214, Université Montpellier II, Place Eugène Bataillon, 34095 Montpellier, France

The impedance of gas contained between two plane walls is a periodic function f the frequency. The frequency interval between two resonances of the gas is equal to c/2D. Furthermore,the amplitude of the resonances is proportional to the pressure.

We describe a signal processing to easily deduce the speed of sound and the pressure of the gas from the impedance spectrum. We show that the modulus of the Fourier transform of the modulus of impedance, called "Tempograph", contains all information about the gas.

In some industrial cases the container is a cylinder or a sphere which can be used as a radial resonator exited by a radial wave [1, 2]. The frequency response of such resonator at high frequencies is quasi-periodic and thus the same signal processing can be used.

[1] M. F. Narbey, et al., " Determination of the composition of a gas mixture in a nuclear fuel rod by an acoustic method." INSIGHT, 2000. 42(9): p. 603-605.

[2] A. Olson, "Helium bottle pressure measurement by portable ultrasonic technique". 1989, Rapport de Boeing n°AD-A208 994, http://stinet.dtic.mil/str/index.html.