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Low frequency composite acoustic sensor for highly absorbing media characterization

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Ultrasonic techniques are widely used in nondestructive testing and evaluation of media. But when media are highly absorbing, it becomes often impossible to operate at classical ultrasonic frequencies.
In this work, we propose a low frequency acoustic device to characterize such highly absorbing media. This device is composed of a piezoelectric disc embedded in a metallic ring. The technique consists in bringing into resonance the entire structure.
Firstly, we will study analytically and numerically the main resonance modes of the sensor, which are the flexion modes and the radial modes. The results of the modelization are compared to measurements obtained through an impedance analyzer.
In a second part, we will use this model of sensor to characterize two different media. The first type consists of a series of polymer disks with different viscoelastic properties. Using radial modes of vibration, we will characterize these polymer disks through measurement of the acoustic velocity. After that, we will characterize using the flexion modes a very complex medium which present a highly absorbing phenomenon such as dough in the fermentation phase. The measurements show the aptitude of this technique to follow the evolution of the physical properties of complex media.