Surface acoustic waves for the characterization of fruit

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Rayleigh-type surface acoustic waves (SAW) [1] are acoustic waves that travel along the surface of a semi-infinite material. The amplitude of SAW is known to decay exponentially with depth depending on the mechanical properties of the material. In geophysics, these SAW, refered as seismic waves, are generated by earthquakes and have been extensively studied to the properties of earth. The main idea of this study is to follow this approach at a different scale by applying a SAW at the surface of an apple in order to get informations about the mechanical properties of the flesh by the mean of a non-destructive ultrasonic method. This idea was applied in a recent publication [2] to determine the hydratation degree of the orange peel.

In a first part, we will develop the model of SAW propagation in polar coordinates by introducing a two dimensional sample made of an aluminium cylinder filled with different materials. This model allows us to plot the dispersion curves associated to each sample and thus, gives important information about the influence of the filling materials. The theoretical results will then be compared to experimental data obtained by applying an ultrasonic pulse that propagates along the cylinder considering the filling material. To get the experimental dispersion curves, the generated SAW are measured by using a laser vibrometer which allows for the determination of the displacement field all around the cylinder.

As an illustration, in a second part, we will apply the same ultrasonic experimental setup to study the SAW propagation along the surface of an apple. The experimental data will also be compared to numerical simulations obtained using a Finite-Difference Time-Domain scheme as presented in [2].

The proposed approach could give interesting informations about the quality of the fruit.....to complete....

[1] Rayleigh Lord J.W.S. *On waves propagated along the plane surface of an elastic solid,* Proceedings of the London Mathematical Society, **17** (1887) 4-11.
[2] N. Jiménez, R. Picó, F. Camarena, J. Redondo, B. Roig. *Postharvest Biol Technol* **67** (2012) 130-137.

