ULTRASONIC WAVES THROUGH AGRICULTURAL SOILS TO DETERMINE THEIR COMPACTION AND POROSITY LEVEL

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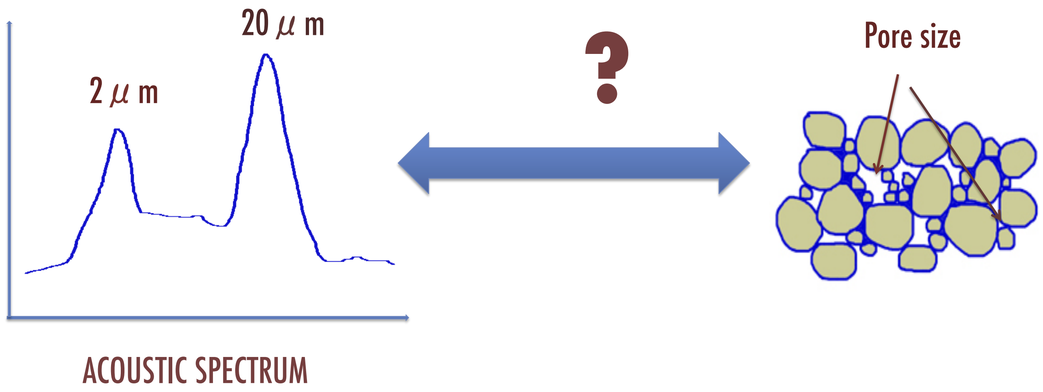
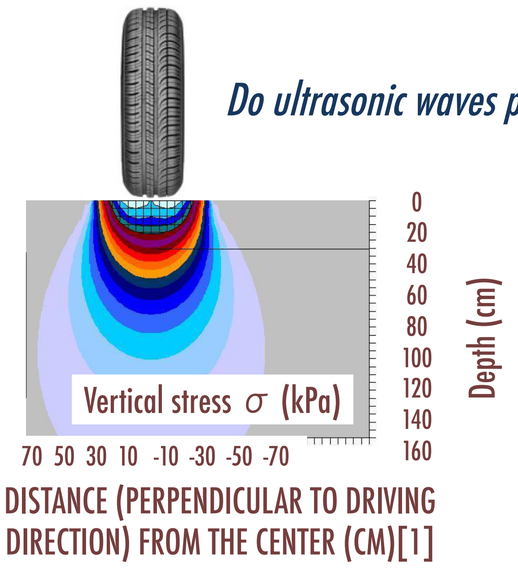
Compaction is one of the major causes of the physical degradation of agricultural soils. The traffic of more and more heavy machines leads to a decrease of the porosity at both the topsoil and subsoil levels. This has negative impacts in agricultural and environmental contexts such as the reduction of soil fertility and water infiltration. This project aims at characterizing in a fast and non-destructive way the state of compaction of an agricultural soil at a local scale using ultrasonic wave propagation. Acoustic signatures of soil samples will be correlated to their compaction level and their porosity distribution. As a result, this methodology could assist in taking restrictive measures such as load limitation of agricultural engines and implementing remedial methods

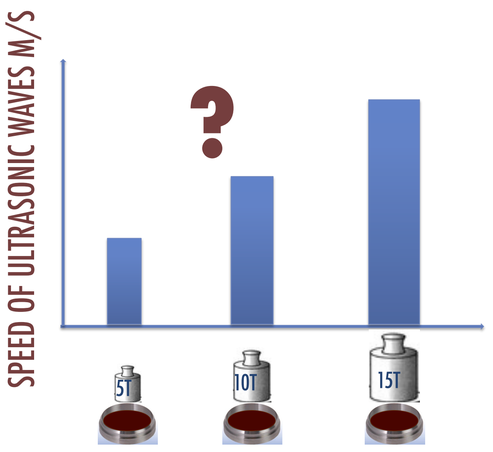
QUESTIONS

Is acoustic spectrum linked to size of pores?

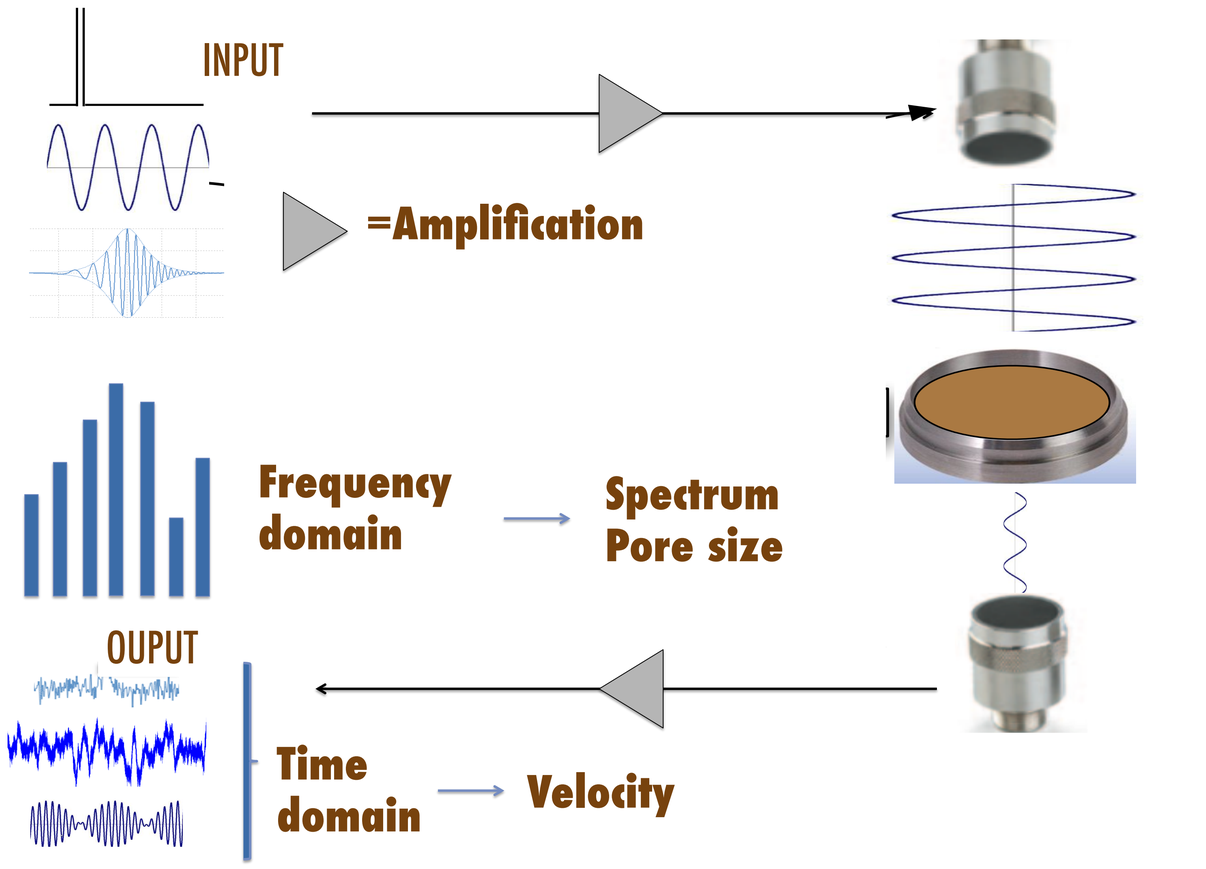


Do ultrasonic waves propagate faster in more compacted soil?





EXPERIMENTAL SETUP

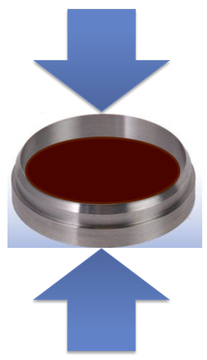


Input signals as pulse, sinusoid and chirp are generated and amplified. Sensors make contact with the sample through ultrasonic gel. The ultrasonic transducer sends the input signal through the sample. The attenuated signal is received by the opposite piezoelectric sensor. Finally, the signal received is amplified and digitized. All the acquisition is controlled with labview. Output signals are treated and postprocessed using Matlab.

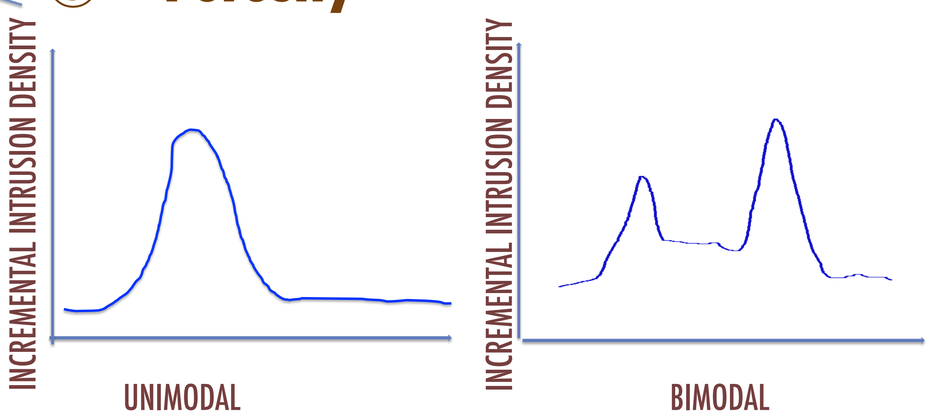
Controlled:

① **Granulometry**

② **Compaction level**
(uniaxial compression / Water content fixed)



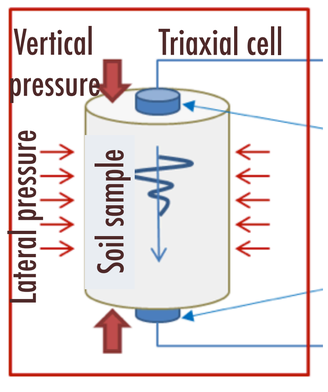
③ **Porosity**



Mercury porosimeter characterizes soil's porosity by applying various levels of pressure to a sample immersed in mercury.

PERSPECTIVES

- *Integration of a triaxial cell in device to take into account the confining pressure and the hydraulic behavior of the soil*
- *Experimental results will be supported by modelling*
- *Correlate signal propagation signature through agricultural soil to water content, microbian life, roots pattern...*



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