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Vibration spectroscopy and guided wave propagation data as indicators of structural and mechanical degradation of human bones

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Vibration spectroscopy and guided wave modes analysis of long bones are investigated as tools to assess bone quality or integrity. Two different methods of vibroacoustic experiments are undertaken to determine the health of dry human tibia bones.

The first method involves vibratory modes of the bone, excited and measured by piezoelectric transducers and sensors respectively. The measured frequency response is validated using finite element simulation (FES), also used in the inverse problem for retrieval of the bone material properties.

The principle of in-plane (IP) and out-of-plane (OP) mode splitting to determine the degree of the damage, that we developed in an earlier study, is applied to classify the bones according to their degree of damage.

The second method involves the analysis of the guided wave phase velocities recovered using the reassigned Gabor spectrogram from signals measured along the diaphysis of the tibias. The frequency difference between the peaks of the split modes are then correlated to the phase velocities of the retrieved Lamb modes.