Stage proposé aux étudiants de Master 2ème année

Imagerie ultrasonore intra-ostéuse du col du fémur

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Context : Bone diseases affect tens of millions of people across the world and create a significant burden in terms of healthcare costs. At present, mostly X-ray approaches are used to evaluate bone health in clinical settings. X-ray measurements performed at the hip and spine are considered as a “gold-standard” for diagnosing osteoporosis. However, it is well accepted that X-ray based methods have strong limitations, in particular a lack of sensitivity and the use of ionizing radiations. Ultrasound (US) is a cheaper, safe and portable modality. It is the modality of choice for measuring children and is preferred in longitudinal clinical studies for ethical and safety reasons [1]. Quantitative ultrasound (US) imaging of cortical bone is an emerging research topic for which we are expecting rapid developments. Our group at LIB has recently obtained the first in vivo images of the inside of cortical bone, enabling a measurement of bone thickness and speed of sound in bone. The developed imaging method has partially solved the issues arising from the strong attenuation of US in bones and the refraction of waves at the soft tissue-bone interface [2].

Objective : Imaging the inside of cortical bone remains a challenge in degraded bones, that is, bone with increased porosity (lower apparent bone mineral density), a phenomenon associated to pathologies and ageing. The objective of the work is to set up an experimental model, using femoral neck tissue, to investigate the capacity of intra-osseous bone imaging (in its current implementation) to image more or less degraded bones. This model will serve as a basis to validate the imaging method for given types of degraded bones, and to test novel imaging algorithms.

Methods : The proximal end of femurs from patients undergoing hip surgery will be imaged both with a programmable ultrasound scanner and with high resolution X-ray computed tomography (resolution about 20 microns) in order to obtain a reference three-dimensional image. The student will be in charge of the design of the measurements and imaging protocols, the measurements, and the analysis. The successful candidate is expected to have a strong interest in biomedical research and signal processing. He/She should have basic experimental, computer, and writing skills. Ideally, he/she will have a background in acoustics (ultrasound) or signal/image processing.

References :