ESRF	**Experiment title:** Evaluation of ultrasound and MRI microscopy using 3D SR CMT on os calces samples	**Experiment number:** LS 875
Beamline: ID19	**Date of experiment:** from: 28/03/98 to: 30/03/98	**Date of report:** 1 sept 98
Shifts:	**Local contact(s):** Jose BARUCHEL	*Received at ESRF:* 01 SEP. 1998

Names and affiliations of applicants (* indicates experimentalists):

Françoise PEYRIN*, CREATIS, INSA & ESRF
Murielle SALOME-PATEYRON, INSA & ESRF
Anne Marie LAVAL-JEANTET, INSA Lyon, FRANCE
Pascal LAUGIER*, LIP URA CNRS 1458, Paris, FRANCE
Genevieve GUILLOT*, U2R2M URA 2212, Orsay, FRANCE

Report:

It **is** now recognized that biomechanical properties of bone depend both on mineral density and micro-architecture. For clinical applications, two investigation techniques are currently emerging : ultrasounds and Magnetic Resonance Imaging (MRI). Ultrasounds are non invasive and deliver acoustic properties such as Bone Ultrasound Attenuation (BUA), or Speed of Sound (SOS). However, a great variability of these parameters is observed, and the impact of structural characteristics on these acoustic properties is presently unknown. MR1 has the potential interest to provide 3D in vivo images of trabecular bone. However since the bone itself is not visible by this technique, it provides an image of the marrow, with a voxel size which is usually anisotropic, and larger than 100 micrometers.

Since 3D Synchrotron Radiation Computerized Microtomography SR CMT allows an accurate analysis of trabecular bone architecture, the purpose of this experiment was to use it as a reference to evaluate results provided by ultrasounds and MRI.

Fifteen entire dry os calcis samples were selected and analyzed using their ultrasonic device by the Laboratoire d'Imagerie Parametrique (LIP, Paris). The mineral content of these samples was already evaluated from quantitative computed tomography (QCT).

On each os calcis, three sub-samples corresponding to different regions of analysis (anterior, median, posterior) were extracted. Using several sub-samples from the same specimen increases the range of variation of density and micro-architectural features.

Thirty of these 7 mm diameter cylinder sub-samples were imaged using SR CMT. For this purpose, the device already experimented on ID19 was used. Optical magnification is used to tailor the pixel size on the detector and the field of view to the desired size. For this study, a pixel size of 10 microns, and a field of view of a 1 cm x 1 cm seemed to be a good compromise. The energy was set to 20 keV. 900 projections images were acquired for each sample, with an exposition time of 1.5 sec.

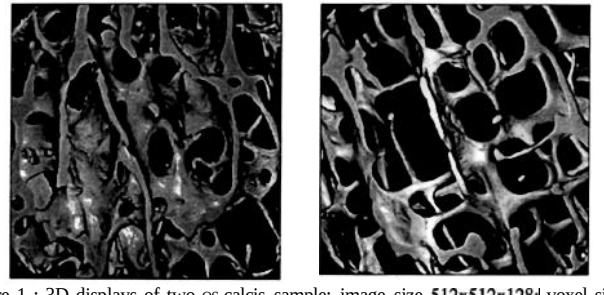

Figure 1 : 3D displays of two os calcis sample; image size 512x512x128; voxel size : 10.13 µm; The imaged volume is (5.2 mm x 5.2 mm x 1.3mm);

All the reconstructions have not been performed yet. After reconstruction, the 3D images will be analyzed to get 3D quantitative architecture parameters. The results will be compared to the ultrasound measurements to study the influence of micro-architecture on ultrasound parameters.

The same samples were also imaged on the MRI microscopy system developed at laboratory of U2R2M (Orsay). The voxel size is of 50 µm x 50 µm x 150 pm. These 3D images will also be segmented and analyzed to get architecture parameters. The parameters obtained from SR CMT and MRI will be compared to evaluate the influence of partial volume effects in MRI, and to study if MRI and SR CMT may provide complementary information's.