

## *Development of an elastography bench for histology and engineered tissue study – Preliminary results*

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To study viscoelastic parameters of small *ex vivo* or engineered tissue samples, Magnetic Resonance Elastography (MRE) has been used during the last few years [1], [2]. It should enable a cautious sample-handling and be performed with a high spatial resolution. We describe here an elastography bench responding to those criteria.

The setup is designed to image small samples (Fig.1). This requires an MRI coil with a high uniformity and filling factor to maximize the signal to noise ratio (SNR). Moreover the sample must be placed in the center of the coil and in contact with the mechanical transducer. Here, the sample holder is designed to slide into a 3D-printed support in which is included a Helmholtz coil tuned with two capacitor trimmers. Matching of the Helmholtz coil is done inductively using a circular coaxial coupling loop tuned at 200MHz. The sample holder is stopped at the center of the coil, guarantying the best RF uniformity and SNR. A cactus needle pierces the sample and is actuated by an MRI-compatible piezoelectric driver at 600Hz.

Two samples were used to test the bench. The first one is made of polymerized fibrinogen (Sigma-F8630), which is used for engineered tissue. To limit motion of the sample, it was surrounded by a stiffer gel (DTM 133460). We also used a healthy rat brain embedded in agarose (Sigma A9414). The two embedding gels have well characterized mechanical properties and can serve as a reference. Acquisition of a FLASH and a MRE-compatible RARE sequence were made with a Bruker 4.7T scanner. Reconstruction of the viscoelastic parameters was done using an adapted method from Sinkus et al. [3].

A voxel of  $0.312 \times 0.312 \times 0.625 \text{mm}^3$  with an SNR of 82.8 and 63.6 were obtained with the FLASH sequence, for the rat brain (Fig.2) and the phantom (Fig.3), respectively. Mean displacement amplitude for the RARE sequence was evaluated at  $1.5 \mu\text{m}$  and  $5.6 \mu\text{m}$ . Storage modulus representing elasticity was 1.8kPa and 1.4kPa. The gel surrounding the sample had an elasticity of 2.6kPa.

Setup was easy to handle. It can be easily adapted to any MRI system. SNR is high and the induced mechanical displacement is enough to reconstruct viscoelastic parameters and highlight differences in elasticity between the commercial gel and the fibrinogen sample. *Ex vivo* results in brain are in agreement with literature [4].

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PEPS CNRS "Balanced".

## References

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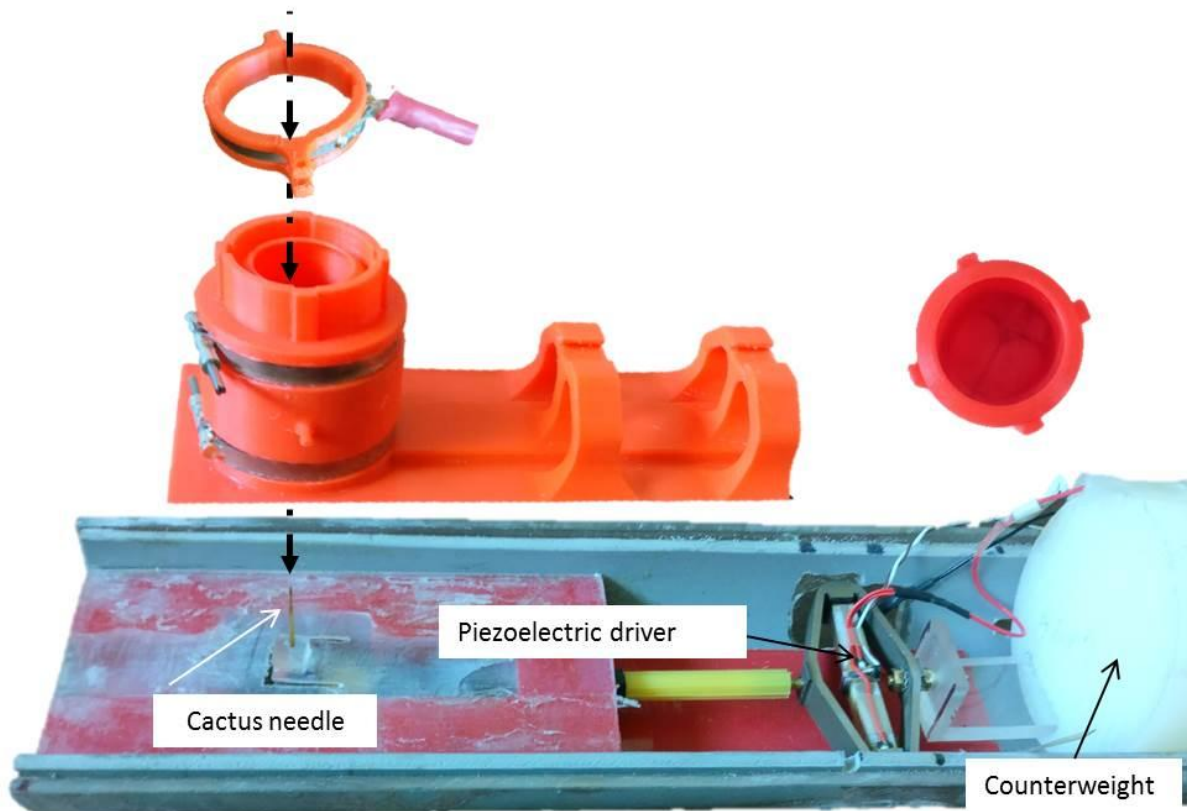


Figure 1: Photography of the different parts of the MR Elastography setup and the sample holder, on the right side

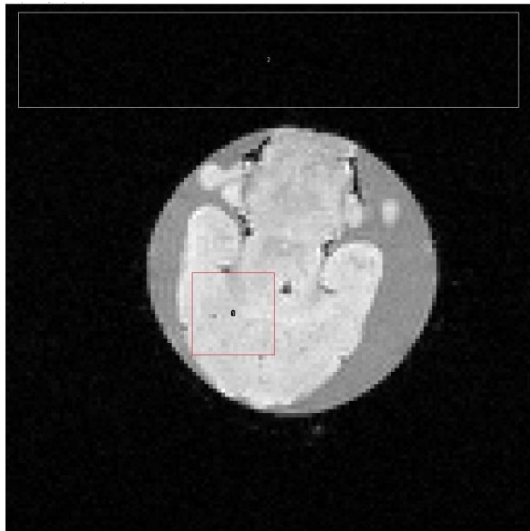


Figure 2: 3D FLASH Coronal image of a rat brain embedded in agarose. Red and white rectangles are ROIs for SNR measurement

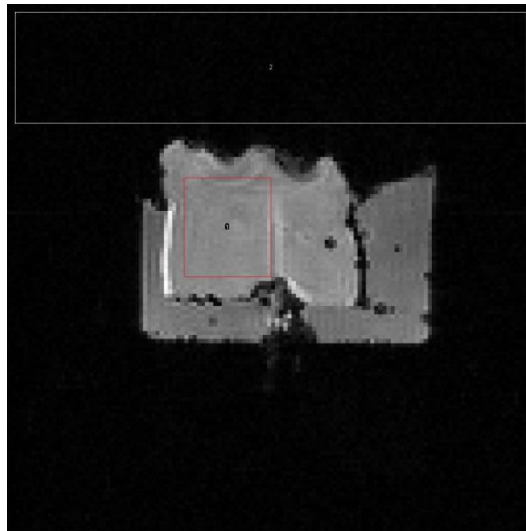


Figure 3: 3D FLASH Axial image of a homogenous fibrinogen phantom, embedded in candle gel. Red and white rectangles are ROIs for SNR measurement