**Postdoctoral position – 24 months**

# Respiratory motion management for extracorporeal HIFU treatment of liver carcinoma guided with US and CT.

## Project context

The proposed position is part of the LYRIC project (Lyon Integrated Research on Cancer), funded by the INCA, the National French Cancer Institute. It is a collaboration between the LabTau (therapeutic applications of ultrasound, INSERM) and the CREATIS (medical imaging, CNRS) laboratories.

## Scientific context

The project concerns the guidance of High Intensity Focused Ultrasound (HIFU) treatments based on the development of a toroidal transducer for large ablations, a technique studied by the laboratory over a number of years for liver metastases (see related papers below). We are now looking at a new clinical device that will allow a fully non-invasive treatment of primary liver tumors (hepatocellular carcinoma) under extracorporeal approach. However, the great mobility of the liver during breathing cycles in a completely non-invasive HIFU treatment approach will require the development of sophisticated treatment strategies to track movement and synchronize the high-power ultrasound application. The ribs and the right lung also notably disturb ultrasonic energy propagation and will be taken into account by the new geometry of the transducer. The latest advances in dynamic x-ray imaging (4DCT) as well as ultrasound-based method for tracking motion of tissues will be combined with a real-time 3-D correction of the focal point location during HIFU therapy. We aim at providing image tools that allow extracorporeal planning and monitoring of the heating in the moving liver.

## Tasks

The goal is to perform the treatment planning of the HIFU intervention based on a 4D CT image. HIFU treatments will then be guided by combining preliminary data from pre-treatment CT scans and peroperative data from real-time ultrasound imaging. The core of the work involves the development of computer algorithms sufficiently accurate, fast and robust to calculate thermal effects, taking into account liver respiratory movements that are involved during treatments. Data acquisition will be performed by radiologists. 4D CT abdominal images and ultrasound images acquisitions will be acquired on patients with primary liver tumors. This dataset will be the basis of the following studies.

Step 1: delivered thermal dose reconstruction taking into account motion. According to the motion observed in 4DCT images of the abdomen, simulations will be carried out to reconstruct the temperature distribution inside the liver and to optimize the treatment. Liver motion and deformation will be modeled from the 4D CT image using deformable image registration method and/or model-based approach.

Step 2: continuous 2D/3D registration between the US per-treatment images and the pre-treatment 4DCT. The goal will be to correlate the position of the liver (and surrounding organs) tracked in 2D US slices with the 3D position in the CT, ideally in real-time. This correlation will be used to provide the practitioner with a feedback on what is currently being heated and to adjust the treatment.

**Skills**

The candidate must hold a PhD in medical imaging or computer sciences.

- Programming skills: C++. Ideally ITK, VTK.
- Ultra-sound imaging
- CT imaging

**Details**

- Location : CREATIS and LabTAU laboratories, Léon Bérard cancer center, Lyon, France
- Salary gross : 2000-2500 € / month
- Duration : 24 months, starting asap (June 2013)

**Contact**

Send a CV and motivation letter to:


- David Sarrut david.sarrut@creatis.insa-lyon.fr
- David Melodelima david.melodelima@inserm.fr
- Simon Rit simon.rit@creatis.insa-lyon.fr