# CEMRACS '08

Modelling and Numerical Simulation of Complex Fluids
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## Modeling & simulations of therapies of liver tumors

***Project proposed by***

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*Goals and Perspectives.*

The present proposal is devoted to modeling and simulations of heat transfer and blood flows in the liver macrocirculation during mini-invasive therapies of liver cancers. Reliable and robust softwares can afterward be incorporated in computer-aided medical decision tools for current practice in order to guide and to optimize the medical check-up and treatment planning.

*Context.*

The liver parenchyma is a hub for the blood circulation. The liver indeed receives one fifth of the total blood flow at any time. Blood flows comprize both portal and hepatic inputs, as well as the hepatic output. The vascular supply comes from the hepatic artery (1/5 to 1/3 of its blood flow) and from the portal vein (2/3 to 4/5 of its blood flow).

The liver parenchyma can develop either primary carcinoma or metastases. Medical practice use minimally invasive therapies in order to reduce cost and to improve patient comfort. However, the medical check-up requires additional informations and the medical procedures must be carefully handled to avoid therapeutic complications. Treatment planning, gesture training are based on computer simulations. Three-dimensional reconstruction of the liver with its large blood vessels is thus required.

Mini-invasive techniques, which are affected by blood flows, include thermal ablation (radiofrequency ablation, cryotherapy, high-frequency focused ultrasound), hence heat transfer. Transport phenomena must be coupled to blood convection taking into account suitable boundary conditions.

Liver transplantation is sometimes needed. The donor liver can regenerate after severe tissue loss, even when up to 75 % of the tissue has been removed. Liver regeneration, which is mainly due to hepatocytes, requires angiogenesis. One month after intervention, the liver growth has reached its preoperative size. New hepatic vascular networks are matured, the vessel growth being influenced not only by growth factors and other involved molecules but also by mechanical factors.

*Work.*

1. Tridimensional reconstruction and facetization (surface discretization) of the liver with its vasculature will be carried out from image acquired in patients ;
2. Blood flow simulations (liver circulation) ;

3. Modeling of heat transfer coupled to blood flow in the liver parenchyma

*Possible perspectives.*

Twin PhD between (1) REO, INRIA & LJLL, UMPC and (2) SCCS, NTU.