

# Analysis of CT abdominal images to optimize the donor/recipient matching in liver transplantation

## Welcome team

MIV team (Modèles, Images et Vision) from the ICube laboratory, University of Strasbourg

## Context

The liver transplantation is currently the best therapeutic option for the treatment about final liver failure and in case of some primitive liver tumors. Each year, in France, about 1.000 liver transplantations are made from cadaverous donors. The grafts allowance is based on a classification system of liver disease gravity, the MELD score [1]. This system gives a score to the recipient given the alteration of its liver and kidney functions. The grafts allowance is exclusively made from this biological score: neither the recipient's morphological characteristics nor the ones of the donor's graft are taken into account. A donor-recipient morphological mismatch may however be dangerous because responsible for two types of syndromes scientifically recognize, the "small for size" and "large for size" syndromes [2, 3]. These syndromes have direct consequences on the patient and graft survival.

The morphological criterion are then essentials to transplant teams: actually, the most adapted graft is always chosen according to morphological criterion more or less objectives like the body mass index or the umbilical perimeter, but also given more subjective criterion as the visual estimation of the graft by the surgeon, from a scanner if possible. In the liver transplantation from living donors, several index has been developed to minimize the mismatch between the graft size and the recipient characteristics. Have an measure index allowing to determine quickly and precisely the morphological matching between the donor and the recipient would be a valuable tool in terms of time and transplant success.

In this context, the internship objective is to develop image processing methods allowing, from 3D CT images (see Figure 1 (a)), to extract volumetric and morphological characteristics of the liver and its vascular structures in order to compute such index.

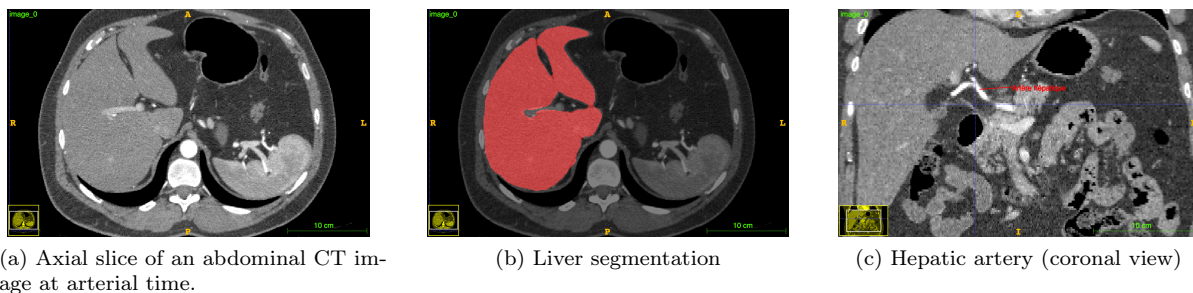


Figure 1: 3D CT image of an abdomen (arterial time).

## Work steps

The internship work will be organized around the following objectives:

### 1) the liver segmentation

The candidate will propose a liver segmentation method (see Figure 1 (b)) that can contain some interactions with the user and can use supervised learning techniques. The objective of the method is to be fast to use in a context where the decision making is very constrained.

## 2) Hepatic artery segmentation

The candidate will propose an hepatic artery segmentation method (see Figure 1 (c)). As previously, this method can be semi-automatic and can require some limited interactions with the user (manual placement of a point in the artery for example).

## 3) Development of quantitative measurements on these structures

The segmented structures will allow to extract certain volumetric and morphological characteristics. For the liver, the volume computing but also some shape measurements, to determine during the internship (length of the hepatic arrow for example). For the hepatic artery, some measures of length (between the celiac trunk and the liver) or diameter could be based on the vessel centerline computing.

This research internship will be in close interaction with Pietro Addeo, surgeon in the liver transplantation service of University Hospitals of Strasbourg.

## Desirable skills

- Medical image processing
- Computer programming (Python and/or C++)

## Supervision

- Vincent NOBLET - MIV team - ICube, Office C211 - [vincent.noblet@unistra.fr](mailto:vincent.noblet@unistra.fr)
- Benoît NAEGEL - Équipe MIV - ICube, Office C230 - [b.naegel@unistra.fr](mailto:b.naegel@unistra.fr)
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- Pietro ADDEO - General, hepatic, endocrine and transplantation surgery service - University Hospitals of Strasbourg

## References

- [1] S. Nair, S. Verma, P.J. Thuluvath Pretransplant renal function predicts survival in patients undergoing orthotopic liver transplantation. *Hepatology*, 35(5):1179–85, 2002
- [2] K. Fukazawa, S. Nishida Size mismatch in liver transplantation. *J. Hepatobiliary Pancreat. Sci.* 23(8):457–66,2017
- [3] M. Allard, F. Lopes, F. Frosio, N. Golse, A. Sa Cunha, D. Cherqui, D. Castaing, R. Adam, E. Vibert Extreme large-for-size syndrome after adult liver transplantation: A model for predicting a potentially lethal complication. *Liver Transplantation* 23(10):1294–1304, 2017