Internship in medical imaging

Segmentation of MRI images for bilio-pancreatic endoscopy

Location : Institut des Systèmes Intelligents et de Robotique (ISIR), Sorbonne University
Advisors : J. Szewczyk (ISIR) / M. Camus (Saint-Antoine Hospital)
Dates : February 2024 – July 2024
Financial support : IUIS - Sorbonne Université
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Context

The MAAGIE project aims to develop a set of software tools to aid endoscopic navigation in the biliopancreatic tract (Fig. 1). Most of these tools are based on a 3D model of the biliopancreatic anatomy of the operated patient (Fig. 2) [1]. In particular, a current thesis focuses on automatic segmentation based on deep learning (DL) of MRI images for the reconstruction of these 3D models [2]. One of the major difficulties in this work lies in the creation of a base of 3D reference models to serve as ground truth during the training phase of the DL-based algorithms. Currently, these reference 3D models are segmented manually, which is very time-consuming or sometimes even impossible.

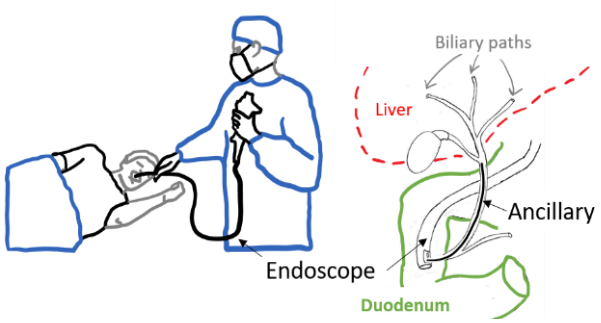

Fig. 1: Access to the bile ducts during ERCP

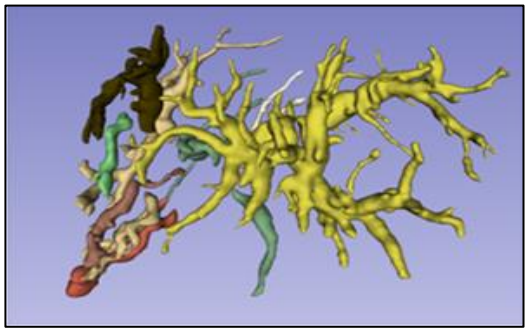

Fig. 2: 3D segmentation of the bilio-pancreatic paths

Aim

The aim of this internship is to develop a computer aid for the manual segmentation of 3D models to create a reliable and sufficient reference base (we are targeting around fifty patients). To do this, two approaches will be explored in parallel:

1. We will develop a manual segmentation support environment offering mask prediction by region growth and propagation from section to section as well as tools for manual rectification of mask contours. To do this, we will use the context of the 3D slicer software namely the Volume, Segmentation and Segment Editor modules [3];
2. We will develop a CNN-based semi-automatic segmentation algorithm based on the MONAI framework [4]. The idea here is to interactively train a DL segmentation model: we first train the model with a reduced existing baseline and then the model infers (approximately) new patient cases which are corrected by an operator before to be added to the learning base etc.

Schedule

1- Familiarization with manual segmentation and specification of the needs (1 month);
2- Bibliographic study and familiarization with the 3D Slicer and Monaï environments (1 month);

3- Developments and tests (3 months);
4- Production of reference segmentations and validation by experts (1 month);

The internship supervision includes a team of three doctors specialized in hepato-biliary endoscopy, including a medical intern on an M2 internship also at ISIR. The candidate will have significant background in computer science and image processing. Knowledge of medical imaging will be a plus. A strong ability to work in a team as well as a high level of autonomy are required.

References

[1] A. Becq, J. Szewczyk, G. Salin, M. Chartier, U. Chaput, R. Leenhardt, X. Dray, L. Arrive, M. Camus, ERCP 2.0: Biliary 3D-reconstruction in patients with malignant hilar stricture, Clinics and Research in Hepatology and Gastroenterology, 2023, (47) 7.

[2] A. Essamlali, V. Millot-Maysounabe, M. Chartier, G. Salin, A. Becq, L. Arrivé, M. Duboc Camus, J. Szewczyk, I. Claude. Bile duct Segmentation Methods Under 3D Slicer Applied to ERCP: Advantages and Disadvantages. Accepted in International Journal of Biomedical Engineering and Clinical Science.

[3] https://www.slicer.org/

[4] A. Diaz-Pinto, S. Alle, A. Ihsani, M. Asad, V. Nath, F. Pérez-García, P. Mehta, W. Li, H.R. Roth, T. Vercauteren, D. Xu, P. Dogra, S. Ourselin, A. Feng, M.J. Cardoso, MONAI Label: A framework for AI-assisted Interactive Labeling of 3D Medical Images, (2022).