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▶ **To cite this version:**

Jonas Lamy, Thibault Pelletier, Guillaume Lienemann, Benoît Magnin, Bertrand Kerautret, et al.. A new 3D Slicer plug-in for the interactive annotation and segmentation of liver anatomy. EASL Liver Cancer Summit (LCS), 2022, En ligne, France. hal-03503706

HAL Id: hal-03503706
https://hal.science/hal-03503706

Submitted on 31 Jan 2022

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A new 3D Slicer plug-in for the interactive annotation and segmentation of liver anatomy

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Background & Aim

Annotation plays a key role in the creation of reference datasets that are useful to evaluate medical image processing algorithms and to train machine learning based architectures.

RVXLiverSegmentation is a 3D Slicer plug-in aiming at speeding-up the interactive annotation and segmentation of liver anatomy from medical images (e.g. CT or MRI).

Method

RVXLiverSegmentation provides 7 main tabs:

- loading and managing medical imaging data;
- liver segmentation;
- annotation of portal veins and segmentation;
- editing portal veins segmentation;
- annotation of hepatic veins and inferior vena cava and segmentation;
- editing hepatic veins and inferior vena cava segmentation;
- tumor segmentation.

Once the medical image data is loaded into 3D Slicer:

- the liver can be segmented either by interactive tools or by automatic a MONAI deep learning-based algorithm (CT only);
- the user places the nodes of important branches and bifurcations;
- reconstructions of hepatic vessels are based on graph structures built from those nodes;
- a VMTK (Vascular Modeling Tool Kit) module segments the vessels by using graphs as initialization;
- the user can edit this segmentation;
- the last tab allows the user to segment interactively possible tumors with dedicated tools and export the scene.

Conclusions

RVXLiverSegmentation is a promising tool for the creation of annotated datasets, and the faithful 3D reconstruction of liver anatomy from medical images.

We first would like to integrate **advanced deep learning models for liver and hepatic vessels segmentation into our RVXLiverSegmentation plug-in**, in order to provide automatic reconstructions that can be then edited by the user. Another important work concerns **the VMTK module, which needs more adaptations for MRI processing**. Finally, a more complete evaluation protocol will be conducted by considering larger patient cohorts.

Acknowledgements

This work was funded by the French Agence Nationale de la Recherche (grant ANR-18-CE45-0018, project R-Vessel-X), http://tgi.ip.uca.fr/r-vessel-x

References

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- J. Lamy et al. (2020) **Preliminary results with a new annotation tool for liver volume and inner vessels from DCE-MRI data**. In VPH 2020, Paris, France, 2020.

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Results

We compared the time of segmentations obtained by

- RVXLiverSegmentation plug-in;
- embedded image processing General Electric AW solution (Server 3.2).

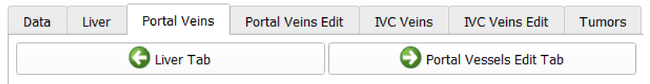
Our cohort was composed of T1 at portal venous phase MR acquisitions of:

- **G1:** 6 non cirrhotic patients;
- **G2**: 4 patients with cirrhosis and HCC.

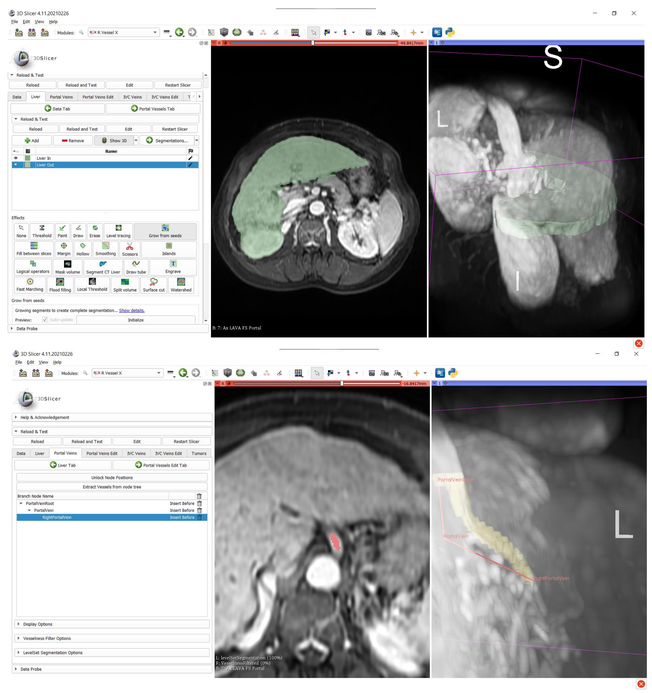
Segmentations (G1)	GE AW	Our plug-in
Liver	10 ± 5 min	3 ± 2 min
Vessels	30 ± 10 min	5 ± 3 min
Total	40 ± 15 min	8 ± 5 min

Segmentations (G2)	GE AW	Our plug-in
Liver	15 ± 10 min	4 ± 2 min
Vessels	35 ± 15 min	7 ± 4 min
Total	50 ± 25 min	11 ± 6 min

Segmentation times for G1 (top) and G2 groups (bottom).



The 7 tabs of the plug-in



Tabs for annotation and segmentation of the liver (top) and vessels (bottom).

Github project