AUTOMATIC SEGMENTATION OF PORTAL VEIN IN CT-SCANS OF THE LIVER

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Introduction: We present a new automatic method to segment the portal vein in 3D helical CTs of the liver at portal time. The purpose is to segment this vein with enough branchings and topological information to localize hepatic tumors with respect to Couinaud's anatomical segmentation.

Materials and Methods: After detecting the liver contours using 3D deformable models, we limit the initial CT images to a mask of liver that contains hepatic tissue, vascular trees, and possibly tumors. To classify these anatomical structures, we fit three Gaussian curves to the intensity histogram using a least squares method. We then segment vascular trees and tumors, by applying a new hysteresis thresholding technique based on a distance map and the thresholds computed from the Gaussian parameters. The resulting vascular system is improved in order to deal with the anisotropy of images and the textured aspect of liver.
First, to obtain an isotropic image, we perform a shape based interpolation on the principal connected component that necessarily contains the portal vein. Then, we compute its skeleton with topological labels and distance information. We remove short branches, loops, and bad connections from the vascular tree. Finally, using the distance information, we reconstruct the portal vein.

Results: Results on 10 patients showed that the algorithm automatically extracts the first three principal bifurcations of the portal vein (see Fig. 1), as well as can be achieved by manual segmentations. They also demonstrated that the skeleton analysis corrects errors of the first segmentation and incorrect vessel connections introduced by 3D reconstruction of the anisotropic images.

Conclusion: We now have all the information necessary to segment the liver with respect to the Couinaud's anatomical segmentation. This will enable us to localize tumors in order to plan a liver resection.

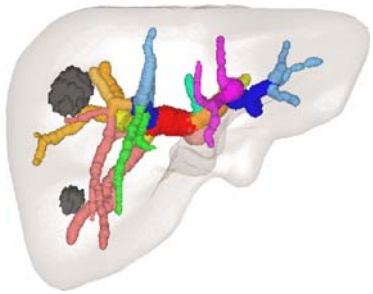

FIG. 1 – *Anterior view of a liver with the portal vein and 2 tumors automatically extracted.*