

LISA - LIVER SURGERY ANALYZER SOFTWARE DEVELOPMENT

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Key Words: *Liver Surgery, CT Image Processing, 3D Semiautomatic Segmentation.*

LISA (Liver Surgery Analyzer) virtual software written in Python programming language is developed in the cooperation with radiologists and surgeons to support liver surgery. The present functions of *LISA* include (1) segmentation of the liver, vessels, and lesions from abdominal CT images, (2) volumetry of the liver and (3) liver lesions volumetry and their relation to the liver vascular tree. Several methods have been tested for the liver and lesions segmentation. Finally the Graph-Cut method [1] is used for the liver segmentation.

Preliminary tests of *LISA* accuracy were done by software engineers. (1) The livers were segmented from patient abdominal CT venous and arterial series of 44 clinical events. The manual with the semiautomatic liver segmentation and volumetry were compared. The manual segmentations of the abdominal CT data before any intervention and after the liver resection were done within last five years as the conventional estimations. DICOM data were saved in the medical information system Medicalc [4] of Teaching Hospital Pilsen, Czech Republic. The DICOM data were anonymized. Nonparametric statistical analyses showed good correlation between both approaches. The median of obtained divergences errors lies between 4% to 5% with $p=0,1$; $p=0,05$ and $p=0,01$. The used semiautomatic method improves at least seven-times the time consuming manual segmentation. 2) The liver semiautomatic segmentation of *LISA* virtual software was tested for 10 competitive CT abdominal data distributed in the framework of the website accessible competition namely “Segmentation of the Liver Competition 2007” [5]. The liver semiautomatic segmentation results were sent to the competition committee. The final evaluation is being expected.

LISA virtual software is prepared for customizing to liver surgery and improving for better usability. All above discussed *LISA* functions are currently tested by radiologists and surgeons for the group of 30 patient anonymized abdominal CT venous and arterial series. More events are taken into account (1) liver manual and semiautomatic segmentation, (2) liver volumetry estimation and processing time evaluation, (3) user-friendly interface, (4) lesions manual and

automatic identification and their categorization into the hypodense, hyperdense and mixed lesion group, (5) threshold parameters sensitivity within the portal and hepatic vein extraction.

The liver segmentation from CT data by *LISA* virtual software is reliable. Nevertheless the segmentation of the liver after the portal vein embolization has to be more studied. Beyond the liver surgery planning procedure simplification and the time efficiency improvement, which are the similar aims of other liver surgery virtual softwares [2], [3], *LISA* virtual software is opened for in future added computational submodules covering research on liver physiology and pathology occurring on the liver parenchyma micro-scale. *LISA* virtual software is able to process CT or PETCT data. It is going to be transform to MR data too, what is important not only for the liver segmentation and the lesions detection.

ACKNOWLEDGEMENT

The work is supported by several research projects IGA MZ ČR 13326 (2012-2015), OP VK Experimental Surgery – New Technologies in Medicine CZ 1.07/2.2.00/15.0049, post-doctoral project LFP04 CZ.1.07/2.3.00/30.0061.

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