Liver tumor segmentation

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A. Could you provide me with details on liver tumour segmentation methods that are currently available with Deep learning with their references?

1. Automatic Liver and Lesion Segmentation in CT using Cascaded Fully Convolutional Neural Networks and 3D Conditional Random Fields - **Patrick Ferdinand Christ 1(B) , Mohamed Ezzeldin A. Elshaer**

2. Fully Convolutional Network for Liver Segmentation and Lesions Detection **- Avi Ben-Cohen 1(B)**

3. 3D Deeply Supervised Network for Automatic Liver Segmentation from CT Volumes - **Qi Dou 1 , Hao Chen 1**

4. Automatic Liver and Tumor Segmentation of CT and MRI Volumes Using Cascaded Fully Convolutional Neural Networks - **Patrick Ferdinand Christ**

5. AUTOMATIC LIVER LESION SEGMENTATION USING A DEEP CONVOLUTIONAL NEURAL NETWORK METHOD - **Xiao Han**

6. Automatic Segmentation of Liver Tumor in CT Images with Deep Convolutional Neural Networks - **Weng Li**

7. Automatic liver tumor segmentation in follow - up CT studies using Convolutional Neural Networks - **Vivanti et al**

8. Deep learning based classification of focal liver lesions withcontrast-enhanced ultrasound - **Khaizhi_Wu**

9. Diagnosis of Focal Liver Diseases Based on Deep Learning Technique for Ultrasound Images - **TarekM,Hassan**

10. Automatic Liver Lesion Detection using Cascaded Deep Residual Networks- Lei Bi

11. Automatic segmentation of liver tumors from multiphase contrast-enhanced CT images based on FCNs - **Sun, Changjian**

12. Liver Fibrosis Classification Based on Transfer Learning and FCNet for Ultrasound Images - **DAN,Meng**

13. LIVER LESION SEGMENTATION INFORMED BY JOINT LIVER SEGMENTATION - **Eugene Vorontsov**

14. Detection-aided liver lesion segmentation using deep learning - **Miriam Bellver**

15. Automatic detection of new tumors and tumor burden evaluation in longitudinal liver CT scan studies. - **Vivanti et.al.**

16. Liver lesion segmentation in CT images with MK-FCN - **Changjian Sun et.al.**

17.   Detection of Liver Tumor Candidates from CT Images Using Deep Convolutional Neural Networks - **Yoshihiro et al.**

18.   ANATOMICAL DATA AUGMENTATION FOR CNN BASED PIXEL-WISE CLASSIFICATION - **Ben Cohen**

19. H-DenseUNet : Hybrid densely connected UNet for liver and liver tumor segmentation from CT volumes - **Xiaomeng Li**

B. The best methods out there for it according to you and why.

There is few papers that has been marked as important from my point of view.

1. Detection of Liver Tumor Candidates from CT Images Using Deep Convolutional Neural Networks - **Yoshihiro et al.**

Reason: They proposed a method for detection of liver tumor (Cyst, FNH, CCC, HCC and metastasis). Used contrast enhanced CT scans with three phases before and after injection of contrast. A combination of convolutional layer, pooling layer and fully connected layer. From convolutional layer the network extracts possible features, with pooling layer minimize the spatial variations and fully connected layer for classification. The results from the paper indicates that their method outperformed conventional method, but the scores are not shown. A table of comparison is provided. This seems to be a very good attempt as they classifies the tumor classes.

2. Automatic Liver and Lesion Segmentation in CT using Cascaded Fully Convolutional Neural Networks and 3D Conditional Random Fields - **Patrick Ferdinand Christ 1(B)**

Reason: In this paper they have used cascaded approach combined with 3D CRF. Initially the segmentation of liver is done, then it is given as the ROI for lesion segmentation. The final results were refined using 3D CRF. They have obtained a very good dice score in less computational time. Also, it is open source and the group have a second publication for both CT and MRI based on this network. I hope this network can be generalized for multiple organ segmentation as they claim.

(Also, the main author is the coordinator for LiTS challenge.)

3.   AUTOMATIC LIVER LESION SEGMENTATION USING A DEEP CONVOLUTIONAL NEURAL NETWORK METHOD

Reason: They combined both U-Net and Res-net features. This method won the title in LiTS challenge, 2017 and still top in the leader-board. This is not open source but I have requested for access to the code.

C. Is there any liver tumour classification out there, other than tumour segmentation? Details of it, if any!

1. Deep learning based classification of focal liver lesions withcontrast-enhanced ultrasound - **Khaizhi Wu**

Classification of focal liver lesions as malignant or benign from 2D frames CEUS videos. Use a combined apporcah of sparse non-negative matrix factorizations and deep belief network.

2. Diagnosis of Focal Liver Diseases Based on Deep Learning Technique for Ultrasound Images - **TarekM,Hassan**

Segmentation of lesions from US preceded by classification of lesions.

3. Liver Fibrosis Classification Based on Transfer Learning and FCNet for Ultrasound Images - **DAN,Meng**

Classifies liver fibrosis

4. ANATOMICAL DATA AUGMENTATION FOR CNN BASED PIXEL-WISE CLASSIFICATION - **Ben Cohen**

Pixel-wise classification for liver lesion analysis

D. Are the current methods for tumour segmentation for both CT and MR or only CT? is there any on US?

The number of publications for tumour segmentation in CT images is much more as compared to MR and US. But we have around 4 publications for Ultrasound and 1 for MR.