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RENAL VESSELS SEGMENTATION

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ABSTRACT

In recent years, there has been a steady increase in the incidence of renal cancer. Available diagnostic medical imaging techniques enable its detection at earlier stage and smaller size. This situation creates favorable conditions for performing a partial nephrectomy, which involves removal of the tumor itself and preserving the remaining healthy part of the organ. A surgical outcome of the procedure is measured by the amount of preserved healthy renal parenchyma which is strongly correlated with a postoperative renal function. In order to facilitate partial nephrectomy the information which vessels directly supply the tumor is required at the preoperative planning stage and can be obtained throughout medical image analysis techniques. The identification of target arteries eliminates the risk of ischemic injury to the remaining healthy part of the kidney that significantly reduce renal function.

The study began with renal vessels segmentation of three anatomical preparations from computed tomography images [1]. Their spatial resolution was equal to (0.293-0.377) mm x (0.293-0.377) mm x (0.400-0.600) mm. A methodology consisted of thresholding with hysteresis and segmentation by the Level Set Method using Chan–Vese model. The three dimensional reconstructions of renal arteriogram were obtained. In addition to the qualitative analysis of the results (continuity of the received contours and adequate mapping of object boundaries), which confirmed the correctness of the applied methodology, also a quantitative analysis was performed. The segmentation results were compared with manual ones. The value of the Dice Coefficient of Similarity was equal to 0.687±0.075. The reconstructions of renal vascular tree obtained by the proposed methods can be used as *a'priori* model in further research.

The next step involved proper modification of the previously proposed approach to adjust its functionality to renal vessels segmentation from patients' preoperative computed tomography scans [2]. In our novel methodology we can distinguish three major steps: preprocessing (binarization and erosion) and two segmentation methods used in sequence i.e. the locally adaptive region growing algorithm and the level set method (using variational approach enabling the incorporation of the Chan–Vese model and image gradient information into the energy functional). The research material consisted of ten computed tomography scans which spatial resolution varied in spacing (0.692 – 0.871) mm and thickness (1 – 3) mm. As the result of the application of the proposed methodology a proper identification of tumor suppling vessels

has been achieved. Again validation was made by comparing the acquired results with manual segmentations. The effectiveness of the proposed method is equal to 0.838±0.078 in terms of Dice Coefficient of Similarity.

We strongly believe that a further research into this scope will lead to substantial contribution in facilitation of partial nephrectomy by providing image guided navigation during surgeries.

REFERENCES

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