Dual optimization based prostate zonal segmentation in 3D MR images

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1   What does this software package solves ?

This software package includes a matlab program which is designed to efficiently solve the 2D multi region image segmentation problem (Potts Model), based on the fast continuous max flow method (CMF) proposed by J. Yuan, E. Bae, X-C Tai and Y. Boykov [2].

The CMF method is used to simultaneously segment the prostate and its two major sub-regions from only a single 2D T2-weighted (T2w) MR image, which makes use of the prior spatial region consistency and incorporates a customized prostate appearance model into the segmentation task [1].

2   What is included in this package ?

1) InteractiveProstateSegmentation2D.m:
This matlab program receives a single 2D T2w MR image and allows the user to segment the image in 2 sections (whole gland and peripheral zone) by initializng 10-12 points. The selected regions are saved in the variable "scribbles" and are then exported as a .mat file called "ProstateLabels.mat" for further segmentation in the "MaxFlowProstateSegmentation2D".m file.

2) MaxFlowProstateSegmentation2D.m:
This function receives the user's scribbles and performs segmentation of the prostate using the fast continuous max flow method. The function gives as output (1)the original image and the (2)segmentation of the background, (3) segmentation of the whole gland, (4) segmentation of the central zone and (5) the segmentation of the peripheral zone of the gland.

3) Potts2D.m:
This function performs a 2D multi region image segmentation problem (Potts Model), based on the fast continuous max flow method (CMF).

4) ComputeLogLikelihood.m:
The function computes the log likelihood from any pixel to correspond to a certain predefined label or region of the image. It returns 0 when the pixel does not correspond to the PDF of the region and 1 when the pixel is inside the PDF of the region.

5) DicomData:
Contains a variety of T2weighted MR images of prostates obtained from different patients.

6) A report in PDF format which contains detailed explanation of each of the methods described aboved.

3   How to use the files ?

1) Load all the contents of this package on your Matlab folder.

2) Open and run the InteractiveProstateSegmentation.m file.

3) A window will pop up allowing the user to collocate points.
   You should select the whole prostate gland using approximately 10 points.

4) A second window will pop up allowing the user to collocate points once again.
   You should select the peripheral zone using approximately 10 points.

5) Verify that a file called "ProstateLabels.m" appears on your Matlab folder.

6) Open the MaxFlowProstateSegmentation2D.m file and run it.

7) Another window should pop up containing the following figures:

- original image T2w MR image in 2D

- segmentation of the background (highlited in white)

- segmentation of the whole gland (highlited in white)

- segmentation of the central zone (highlited in white)

- segmentation of the peripheral zone (highlited in white)

References

[1] Wu Qiu, Jing Yuan, Eranga Ukwatta, Yue Sun, Martin Rajchl, and Aaron Fenster. Dual optimization based prostate zonal segmentation in 3d mr images. *Medical image analysis*, 18(4):660–673, 2014.

[2] Jing Yuan, Egil Bae, Xue-Cheng Tai, and Yuri Boykov. A continuous max-flow approach to potts model. In *European conference on computer vision*, pages 379–392. Springer, 2010.