Fully automatic segmentation of the hippocampus in MR images

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Introduction

There is an increasing interest in volumetric measurements of the hippocampus. Manual outlining of the structure is time consuming and rather imprecise. Automatic segmentation, however, is a difficult task since hippocampus is surrounded by different kinds of tissues. In some positions there is no local feature that characterises the border, which then must be defined by its neighbourhood. **Aim:** Develop a fully automatic procedure for the segmentation of the hippocampus in standard quality MR images

Material and methods

Subjects: 6 healthy volunteers. **MRI:** Philips Gyroscan NT5 (0.5 T), T1-weighted Gradient Echo 3D-scan of the brain. **Segmentation procedure:** The signal intensity in the MR image was value encoded to yield 4 channels representing gray matter, white matter, CSF and fat. Detection of the hippocampus contour in 1 volunteer was obtained in coronal sections of the channel representation using trainable matched filters [1]. The matched filters were initially trained on manually segmented coronal sections in 5 volunteers to identify a series of points along the contour of hippocampus. This initial contour was refined using level sets. The output of a quadrature edge detection filter was used as input to the speed function driving the contour propagation in the level set method. Because the analysis is performed in frontal sections, the frontal and rear ends of the Hippocampus can be very difficult to define. Therefore, anatomical landmarks in transversal slices were used to detect the range of sections containing the hippocampus. These landmarks were automatically located using the same kind of trainable filters as for the contour. The whole process described above is fully automatic. No manual interaction was required.

Results and discussion

The hippocampus was successfully segmented using a novel approach. The precision of the segmentation method varied for different images. A typical initial contour found by the trained filters is shown in figure 1. Within the marked area, dark parts can be seen in the upper and right-hand part. These should not be considered part of the hippocampus. The contour was then used as initialisation data to the level sets method. In the resulting final contour the border has been significantly improved (figure 1). Figure 2 shows a surface rendered hippocampus volume.

References

1. M. Borga, H. Malmgren, and H. Knutsson. FSED - feature selective edge detection. In Proceedings of 15th International Conference on Pattern Recognition, 2000;1:229–232. IAPR.

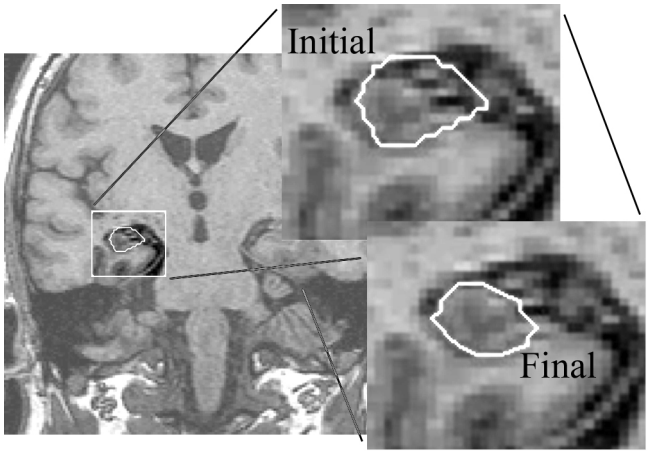

Figure 1. A coronal section with an outline of the right hippocampus

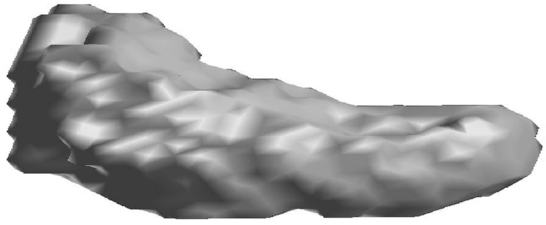

Figure 2. 3D image of the hippocampus.