Morphological Analysis of Brain Structures using 3D Wavelet

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Abstract. This work presents new results on 3D shape analysis with application to brain structure characterization of MRI images. This study addresses such a problem by exploring the 3D wavelet transforms as a multiscale tool to analyse brain data. The obtained results corroborates the capability of such multiscale geometrical features for identification of distinct brain structures.

1 Introduction

This study investigates differences in the shape of different anatomic structures. Encouraging results in this regard may lead to futher developments in automatic identification of neuroanatomical abnormalities in dyslexic [2], schitzophrenic, autistic and other diseased subject populations. It is assumed that the structure of interest is either traced or segmented automatically from magnetic resonance images as sequences of points similar to level curves along a series of slices. So as a preliminary step, we applied a preprocessing these slices to obtain a volumetric structure (see Figure 1(a)).

2 Feature extraction

An important procedure to characterize surfaces regards their normal field, which is obtained without the need for a parameterized surface. Instead, we have developed an approach to derive a volumetric representation from the contours, which can be suitably analyzed by 3D wavelet transforms [1]. The potential of the wavelet transform stems from its capabilities for detecting and characterizing singularities, extracting instantaneous frequencies and producing multiscale measures. Once the normal field of surface is obtained we study its behavior through measurements that take into account their geometrical properties in terms of a set of meaningful features, which are invariant to rotation, translation and scaling. The selected features are: eigenaxes ratios and local orientation distributions, regarding density histograms obtained for the orientation of the normal vectors along determined neighborhood around each of the surface element.

3 Discussion

Some of the main advantages of the proposed framework include the fact that there is no need for obtaining a parameterized representation of the 3D data and the features invariance to rotation and translation. The experimental results (see Figure 1(b)) confirmed the performance of the presented method.

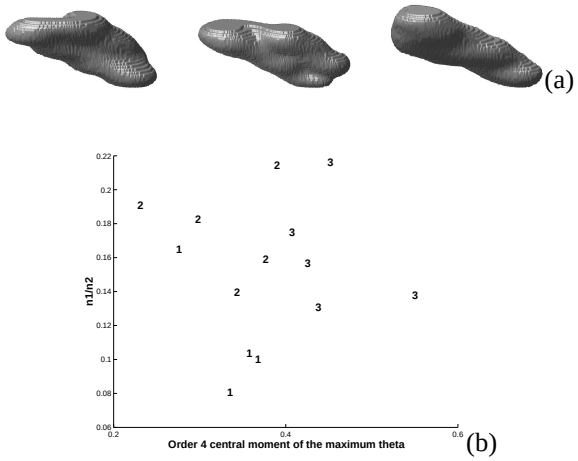

Figure 1: (a) Left-to-right: Examples of structures belong to classes 1, 2 and 3 respectively; (b) Feature space otained by visual analysis considering all 2 by 2 combination of features.

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