Hurdal, Monica K.; Gutierrez, Juan B.; Laing, Christian; Smith, Deborah A.
Shape analysis for automated sulcal classification and parcellation of MRI data. (English)

Summary: We describe geometric invariants that characterize the shape of curves and surfaces in 3D space: curvature, Gauss integrals and moments. We apply these invariants to neuroimaging data to determine if they have applications for automatically classifying and parcellating cortical data. The curves of sulci and gyri on the cortical surface can be obtained by reconstructing cortical surface representations of the human brain from magnetic resonance imaging (MRI) data. We reconstructed gray matter surfaces for 15 subjects, traced 10 sulcal curves on each surface and computed geometric invariants for each curve. These geometric features were used to classify the curves into sulcal and hemispheric classes. The best classification results were obtained when moment-based features were computed on the sulcal curves in native space. Gauss integral measures showed that they were useful for differentiating the hemispheric location of a single sulcus. These promising results may indicate that moment invariants are useful for characterizing shapes on a global scale. Gauss integral invariants are potentially useful measures for characterizing cortical shape on a local, rather than global scale. Gauss integrals have found biological significance in characterizing proteins, so it is worthwhile to consider their possible applications, to neuroscientific data.

MSC:
92C55 Biomedical imaging and signal processing
92C20 Neural biology
92C50 Medical applications (general)
53A99 Classical differential geometry

Keywords:
geometric invariants; shape descriptors; curvature; Gauss integrals; moments; data mining; pattern classification; MRI data; sulcal curves; cortical shape

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References: