Abstract

Cerebral glioma is the most prevalent primary brain tumor, which are classified broadly into low and high grades according to the degree of malignancy. High grade gliomas are highly malignant which possess a poor prognosis, and the patients survive less than eighteen months after diagnosis. Low grade gliomas are slow growing, least malignant and has better response to therapy. To date, histological grading is used as the standard technique for diagnosis, treatment planning and survival prediction.

The main objective of this thesis is to propose novel methods for automatic extraction of low and high grade glioma and other brain tissues, grade detection techniques for glioma using conventional magnetic resonance imaging (MRI) modalities and 3D modelling of glioma from segmented tumor slices in order to assess the growth rate of tumors. Two new methods are developed for extracting tumor regions, of which the second method, named as Adaptive Gray level Algebraic set Segmentation Algorithm (AGASA) can also extract white matter and grey matter from T1 FLAIR an T2 weighted images. The methods were validated with manual Ground truth images, which showed promising results. The developed methods were compared with widely used Fuzzy c-means clustering technique and the robustness of the algorithm with respect to noise is also checked for different noise levels. Image texture can provide significant information on the (ab)normality of tissue, and this thesis expands this idea to tumour texture grading and detection. Based on the thresholds of discriminant first order and gray level co-occurrence matrix based second order statistical features three feature sets were formulated and a decision system was developed for grade detection of glioma from conventional T2 weighted MRI modality. The quantitative performance analysis using ROC curve showed 99.03% accuracy for distinguishing between advanced (aggressive) and early stage (non-aggressive) malignant glioma. The developed brain texture analysis techniques can improve the physician’s ability to detect and analyse pathologies leading to a more reliable diagnosis and treatment of disease. The segmented tumors were also used for volumetric modelling of tumors which can provide an idea of the growth rate of tumor; this can be used for assessing response to therapy and patient prognosis.