

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 7, July 2015

Multi-Modal Fractal Analysis of Lesion Cells

Amrutha.M¹, S. Geetha*²

¹ Assistant Professor, Department of Biomedical Engineering, Jerusalem College of Engineering, Chennai, India

^{2*} Corresponding Author, Assistant Professor, Department of Biomedical Engineering, Bharath University, Chennai, India

ABSTRACT: Fractal dimension is an important tool for the analysis of medical images. MR images and the mammographic images give a detailed view of both benign and malignant lesions. This work focuses on the extraction of boundary and analysis of its fractal dimensions to classify the benign and malignant lesions. The boundary of the lesion is extracted using fuzzy c-means clustering. The lesion contour is then converted into time series using “freeman’s chain code”. The resultant time series is used for fractal analysis using non-linear technique called Higuchi algorithm. This algorithm generates a single value which discriminates between benign and malignant structures. This classification of lesions is made using k-nearest neighbor pattern classifier. As a means of confirming the result the histopathological images of the tissues were used. The steps involved include selecting the region of interest of the histopathological images and analysis of its fractal dimensions to classify the benign and malignant lesion cells. Box-Counting algorithm is applied on the selected region to obtain various fractal features such as coarseness, lacunarity and complexity of the cells. Based on the obtained values classification of lesions is made using k-nearest neighbor pattern classifier. The results proved that these methods serve as an effective tool for diagnosis

KEYWORDS: Fractal dimension, MATLAB, c-means clustering, freeman’s chain code, Higuchi algorithm, Box-Counting, lacunarity, coarseness and complexity, K-NN classifier.

I. INTRODUCTION

GLIOMA: The most common type of primary brain tumors are the gliomas. Gliomas arise from glial cells which are supportive cells that surround, nourish and protect neurons. Gliomas are named according to the specific type of cell they most closely resemble. The four main types of glioma:

- i. Ependymomas (ependymal cells).
- ii. Astrocytomas (astrocytes), of which glioblastoma multiforme is the most common.
- iii. Oligodendrogliomas (oligodendrocytes).

BREAST CANCER: Breast cancer is a disease in which malignant (cancer) cells form in the tissues of the breast. There are many types of breast cancer that differ in their capability of spreading (metastasizing) to other body tissues. Mostly they are classified either as *Benign or Malignant tumors*

DIAGNOSIS: The main way of identifying a tumor is by the use of an MRI (magnetic resonance imaging) or a CT scan (computerized tomography) combined with an analysis of the tissue. Because of the distinct appearance, the doctor is able to have a fairly good idea of the tumor type by examining the MRI scan. But for a definitive diagnosis, a sample of the tumor must be analyzed by a pathologist.

CT Scan: It provides successive X-ray views of thin sections of the tumor area. Contrast agents are given by injection before CT scanning to improve the readability of the scan.

MRI: This is a very precise and sensitive tool for evaluating the tumors. Unlike CT scanning, an MRI does not rely on radiation, but makes use of magnetic field patterns with a contrast agent. For evaluating a tumor and follow-up, an MRI

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 7, July 2015

is generally the preferred method. Generally for breast cancers, Mammograms are best imaging test to study about the lumps.

BIOPSIES: They are used to obtain a sample of tissue from the tumor site. Safety and the location of the tumor determine the most appropriate biopsy procedure. If a tumor is deemed to be operable, the sample is obtained at the same time as the surgery. If a tumor is difficult to access, a stereotactic (or needle) biopsy may be used. A pathologist examines the tissue under a microscope to classify the tumor type and its grade, which can range from benign to malignant [1-2].

II. NEED FOR THE PROJECT

To propose an effective method for characterization and classification of various tumors using Fractal Analysis technique in GUI and to classify the types of tumors based on its malignancy. This work mainly focuses on Glioma (a type of brain tumor) and Breast Cancer [10-12].

III. METHODOLOGY

PROCESSING OF MRI AND MAMMOGRAM IMAGES

The preprocessing steps include importing the MRI and mammogram images to Matlab, resizing it, applying median filter on it and enhancing it. Following these procedures the boundaries of the tumor sites are extracted. The extracted boundary is then converted into Time series plot using Freeman chain code and fractal analysis is performed using Higuchi's Algorithm. Further classification is done using K-Nearest Neighbor classifier [13-14].

OVERVIEW:

1. Import MRI image
2. Enhancement & Thresholding
3. Boundary Tracing
4. Segmentation
5. Freeman's Chain Code
6. Fractal Analysis & classification
- 7.

PROCESSING OF HISTOPATHOLOGICAL IMAGES

Histopathological tissue analysis by a pathologist represents the definitive method (a) for confirmation of presence or absence of disease, and (b) disease grading, or the measurement of disease progression.

BOX COUNTING ALGORITHM: In order to determine the lacunarity and fractal dimension average values, Coarseness and complexity from the histopathological image, Box counting algorithm is implemented [15], [5]. The steps and the functions used are described below:

- a) Getting the image
- b) Performing non-linear filtering on a varying size pixel block [3].
- c) Computing the slope using linear regression
- d) Selecting a Region of Interest & finding corresponding average FD and Lacunarity
- e) Executing on button press [4].

OVERVIEW:

Parameters estimated for Grade classification

1. Coarseness
2. Complexity

Algorithms used for Type Determination

1. Box Counting Algorithm
2. Power spectrum

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 7, July 2015

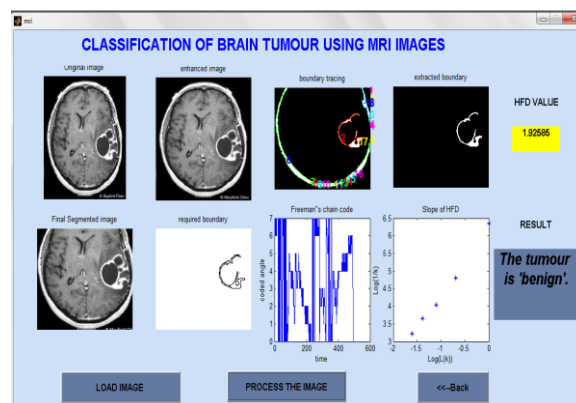
III. CLASSIFIER

The k -NN classifier is an instance-based classifier that works for classification of unknown instance by comparing it with the known according to some distance/similarity function [16]. The intuition is that two instances far apart in the instance space defined by the appropriate distance function are less likely than two closely situated instances to belong to the same class [7-9].

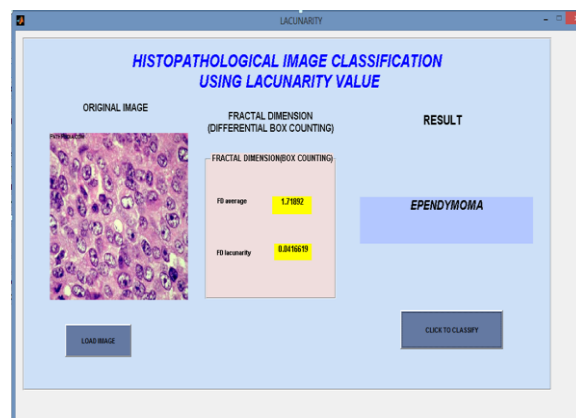
MRI & MAMMOGRAM: The values obtained from fractal characterization are analyzed. The HFD values are considered for the classification of tumoral lesions using the K-nearest neighbour pattern classification [17-18].

HISTOPATHOLOGY: The values obtained from fractal characterization are analyzed. The Coarseness and Complexity values are considered for the classification of the grades of tumor using the K-nearest neighbor pattern classification [19], [6].

IV. RESULTS AND DISCUSSION



GUI based classification of Brain Tumor using MRI images



GUI based classification of Brain Tumor using HISTO images

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 7, July 2015

V. CONCLUSION

The differentiation between malignant and benign structures appears immediately from visual inspection of the contour maps obtained in both cases. The Higuchi fractal dimension for the contour associated time series discriminates between benign and malignant lesions. Box counting Algorithm computes the fractal values Lacunarity, coarseness and complexity of the tumor cells thereby helps in confirmation of the result obtained using MRI and mammogram images.

REFERENCES

1. J.A.Sylvia, K.B.Dharani, et al , Department of Biomedical Engineering, Jerusalem College of Engineering : Characterization of Lesion Contour in Brain Using Fractal Analysis,2012
2. Jayalakshmi T., Krishnamoorthy P., Ramesh Kumar G., Sivamani P., "Optimization of culture conditions for keratinase production in Streptomyces sp. JRS19 for chick feather wastes degradation", Journal of Chemical and Pharmaceutical Research, ISSN : 0975 – 7384, 3(4) (2011) PP.498-503.
3. Angelini, E. D., et al.: Glioma Dynamics and Computational Models: A Review of Segmentation, Registration, and In Silico Growth Algorithms and their Clinical Applications. Current Medical Imaging Reviews, 3, 2007.
4. T. Lipping. Nonlinear digital filtering of physiological signals. Medical & Biological Engineering & Computing, vol. 37, suppl. 1, 1999, pp. 73-76
5. Jebaraj S., Iniyan S., "Renewable energy programmes in India", International Journal of Global Energy Issues, ISSN : 0954-7118, 26(4Mar) (2006) PP.232-257.
6. Carmalyn Lubawy ,Melissa Skala : Algorithm for Morphological Cancer Detection,2004
7. Hang Chang, Gerald V Fontenay, Ju Han, Ge Cong et al: Morphometric analysis of TCGA glioblastoma multiforme.
8. J. MORLET, G. ARENS, E. FOURGEAU, D. GIARD.1982 Wave Propagation and Sampling Theory I ET II Geophysics, 47 pp 203-236.
9. Brain Image Segmentation N.Senthilkumaran and R. Rajesh School of Computer Science and Engineering Bharathiar University, Coimbatore - 641046, India.
10. Automated Segmentation and Classification of Brain Magnetic Resonance Imaging C615 project by Luiza Antonie
11. MRI Brain Image Segmentation by Fuzzy Symmetry Based Genetic Clustering Technique Sriparna Saha, Student Member, IEEE and Sanghamitra Bandyopadhyay, Senior Member, IEEE Machine Intelligence Unit, Indian Statistical Institute, Kolkata, India-700108
12. Wild J. Dimensioner och fraktal geometri. 2010 February
13. Niranjan U., Subramanyam R.B.V., Khanaa V., "Developing a Web Recommendation System Based on Closed Sequential Patterns", Communications in Computer and Information Science, ISSN : 1865-0929, 101() (2010) PP.171-179.
14. Localization of Tissues in High Resolution Digital Anatomic Pathology Images Raja' S. Alomaria, Ron Allen, Bikash Sabata, and Vipin ChaudharyaUniversity at Buffalo, SUNY, Buffalo, NY 14260 Bioimagine Inc., Cupertino, CA 95014 Automatic Detection of Sinusitis and Analyzing the Severity with Preventive Measures using GUI MATLAB Tools P SasiKiran, M.Sailaja
15. Das S., Das M.P., Das J., "Fabrication of porous chitosan/silver nanocomposite film and its bactericidal efficacy against multi-drug resistant (MDR) clinical isolates", Journal of Pharmacy Research, ISSN : 0974-6943, 6(1) (2013) PP. 11-15.
16. K. Tingelhoff, K.W. Eichhorn, I. Wagner, R. Westphal, F.M. Wahl, F.Bootz. Analysis of Manual Segmentation in Medical Image Processing. Accepted at Thematic Conference on Computational Vision and Medical Image Processing ECCOMAS VIPIMAGE, 2007
17. G. Strauss, K. Koulechov, R. Richter, A. Dietz, T. C.Lueth, "Navigated Control in functional endoscopic sinus surgery".Int J Medical Robotics and Computer Assisted Surgery, vol. 1, no. 3, 2005, pp. 31-41.
18. Gopalakrishnan K., Prem Jeya Kumar M., Sundeeep Aanand J., Udayakumar R., "Thermal properties of doped azopolyester and its application", Indian Journal of Science and Technology, ISSN : 0974-6846, 6(S6) (2013) PP. 4722-4725.
19. Q. Duan, D. Moses, M. B. Srichai, V. M. Pai, A. F. Laine. . Semi-Automatic Ventricular Border Segmentation Package Based on Multi- Phase Levelset Segmentation," International Society for Magnetic Resonance in Medicine (ISMRM) 14th Scientific Meeting & Exhibition, pp.1014
20. AR.Arunachalam, Imperceptible Digital Image Watermarking, International Journal of Innovative Research in Computer and Communication Engineering, ISSN(Online): 2320-9801, pp 1321-1326, Volume 1, Issue 6, August 2013.
21. AR.Arunachalam, Spectrum Reuse in Multiple Primary User Environment, International Journal of Innovative Research in Computer and Communication Engineering, ISSN(Online): 2320-9801,pp 1475-1480, Volume 1, Issue 7, September 2013
22. B.Sundar Raj, A Third Generation Automated Teller Machine Using Universal Subscriber Module with Iris Recognition, International Journal of Innovative Research in Computer and Communication Engineering, ISSN (Online): 2320 – 9801,pp 565-571, Vol. 1, Issue 3, May 2013
23. B.Sundar Raj, The Efficiency of the Scalable Architecture for Revealing and Observing the Environment using Wireless Sensor, International Journal of Innovative Research in Computer and Communication Engineering, ISSN (Online): 2320 – 9801,pp 63-67, Vol. 1, Issue 1, March 2013
24. C.Anuradha, An Efficient Detection of Black Hole Attacks in Tactical MANETs, International Journal of Innovative Research in Computer and Communication Engineering, ISSN(Online): 2320-9801,pp 1636-1645, Volume 1, Issue 8, October 2013