USING FUZZY C-MEANS CLUSTERING ALGORITHM AND GENETIC ALGORITHM TO SEGMENT MAGNETIC RESONANCE IMAGES

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ABSTRACT

In this research, a segmentation technique which is combined by fuzzy C-means Clustering Algorithm (FCM) and Genetic Algorithm (GA) is proposed for segmenting human brain magnetic resonance images (MRI) to find the location of Meningioma. The FCM algorithm is used to decide for the better clustering center. The GA is used to determine the network construction and the prototype optimization. This goal can be accomplished by the following steps: 1. selecting the membership function assigned to the weight vectors of a fuzzy algorithm for learning vector quantization (FALVQ) competitive neural network (NN); 2. determining the effect of the non-winning prototypes on the attraction between the winning prototype and the input of the network; 3. execluting the genetic operations including selection, reproduction, crossover, and mutation until obtain the optimization of NN topology, The experimental results indicate that the proposed approach can identify different tissues and discriminate between normal tissues and abnormalities in human brain with Meningioma.

Keywords : Fuzzy Theory ; Learning Vector Quantization ; Fuzzy C-means Clustering Algorithm ; Magnetic Resonance Images ; neural network ; Genetic Algorithm

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REFERENCES

1. BROWN, M. A. AND SEMELKA, R. C., MRI: BASIC PRINCIPLES AND APPLICATIONS, 2ND EDITION, WILEY-LISS, NEW YORK, 1999. 2. CHO, S., "PATTERN RECOGNITION WITH NEURAL NETWORKS COMBINED BY GENETIC ALGORITHM," FUZZY SETS AND SYSTEMS, VOL. 103, PP. 339-347, 1999. 3. CHUANG, K., CHIU, M., LIN, C., AND CHEN, J., "MODEL-FREE FUNCTIONAL MRI ANALYSIS US -ING KOHONEN CLUSTERING NEURAL NETWORK AND FUZZY C-MEANS," IEEE TRANSACTIONS ON MEDI -CAL IMAGING, VOL. 18, NO. 12, PP. 1117-1128, DEC. 1999. 4. CLINE, H. E., LORENSEN, W. E., KIKINIS, R., AND JOLSEZ, F., "THREE-DIMENSIONAL SEGMEN -TATION OF MR IMAGES OF THE HEAD USING PROBABILITY AND CONNECTIVITY, " JOURNAL OF COM PUTING ASSISTANT TOMOGRAPHY, VOL. 14, PP. 1037-1045, 1990. 5. GOLDBERG, D. E., GENETIC ALGORITHMS IN SEARCH, OPTIMIZATION, AND MACHINE LEARNING,ADD -ISON WESLEY, READING, MA, 20TH PRINTING, NOV. 1999. 6. GUROCAK, H. B., "A GENETIC -ALGORITHM-BASED METHOD FOR TUNING FUZZY LOGIC CONTROLLERS, " FUZZY SETS AND SYSTEMS, VOL. 108, PP. 39-47, 1999. 7. HALL, L. O., BENSAID, A. M., CLARKE, L. P., VELTHUIZEN, R. P., SILBIGER, M. S., AND BEZ -DEK, J. C., "A COMPARISON OF NEURAL NETWORK AND FUZZY CLUSTERING TECHNIQUES IN SEGMEN -TING MAGNETIC RESONANCE IMAGES OF THE BRAIN," IEEE TRANSACTIONS ON NEURAL NETWORKS, VOL. 3, NO. 5, PP. 672-682, SEP. 1992. 8. ISHIGAMI, H., FUKUDA, T., SHIBATA, T., AND ARAI, F., "STRUCTURE OPTIMIZATION OF FUZZY NEURAL NETWORK BY GENETIC ALGORITHM," FUZZY SETS AND SYSTEMS, VOL. 71, PP. 257-264 , 1995. 9. J. C. BEZDEK, PATTERN RECOGNITION WITH FUZZY OBJECTIVE FUNCTION ALGO-RITHMS. NY: PLENUM, 1981. 10. KARAYIAMMIS, N. B., "A METHODOLOGY FOR CONTRUCTING FUZZYALGORITHMS FOR LEARNING VECTOR QUANTIZATION," IEEE TRANSACTIONS ON NEURAL NETWORKS, VOL. 8, NO. 3, PP. 505-518, MAY. 1997. 11. KARAYIAMMIS, N. B. AND PIN-I PAI., "A FUZZY ALGORITHMS FOR LEARNING VECTOR

QUANTIZATION, " IN INTELLIGENT ENGINEERING SYSTEMS THROUGH ARTIFICIAL NEURAL NETWORKS, VOL.4, C. H. DAGLI ET AL., EDS.NEW YORK:ASME PRESS,PP.219-224, 1994. 12. KARAYIAMMIS, N. B. AND PAI, P., "SEGMENTATION OF MAGNETIC RESONANCE IMAGES USING FUZZY ALGORITHMS FOR LEARNING VECTOR QUANTIZATION," IEEE TRANSACTIONS ON MEDICAL IMAGING, VOL. 18, NO.2, PP. 172-180, FEB. 1999. 13. LIANG, Z., "TISSUE CLASSIFICATION AND SEGMENTATION OF MR IMAGES," IEEE ENGINEERING IN M -EDICINE AND BIOLOGY, PP. 81-85, MARCH 1993. 14. LIANG, Z. AND LAUTERBUR, P. C., PRINCIPLES OF MAGNETIC RESONANCE IMAGING: A SIGNAL PROC -ESSING PERSPECTIVE, SPIE PRESS AND IEEE PRESS, BELLINGHAM WA, 2000. 15. LONG, D. T., KING, M. A., AND PENNY, B. C., "2-D VERSUS 3-D EDGE DETECTION AS A BASIS FO -R VOLUME QUANTIZATION IN SPECT, "INFORMATION PROCESSING OF MEDICAL IMAGING, PP. 457-471, 1991. 16. OZKAN, M., DAWANT, B. M., AND MACIUNAS, R. J., "NEURAL-NETWORK-BASED SEGMENTATION OF MUL -TI MODAL MEDICAL IMAGES: A COMPARATIVE AND PROSPECTIVE STUDY," IEEE TRANSACTIONS ON MED -ICAL IMAGING, VOL. 12, NO. 3, PP. 534-544, SEP. 1993. 17. PAL, N. R., BEZDEK, J.C., AND TSAO, E. C., "GENERALIZED CLUSTERING NETWORKS AND KOHONEN'S SELF-ORGANIZING SCHEME," IEEE TRANSACTIONS ON NEURAL NETWORKS, VOL. 4, PP. 549-557, JULY 1993. 18. PHAM, D. L. AND PRINCE, J. L., "ADAPTIVE FUZZY SEGMENTATION OF MAGNETIC RESONANCE IMAGES," IEEE TRANSACTIONS ON MEDICAL IMAGING, VOL. 18, NO. 9, PP. 737-752, SEP. 1999. 19. S.BANERJEE, D.P. MUKHERJEE, D. DUTTA MAJUMDAR,"FUZZY C-MEANS APPROACH TO TISSUE CLASSIFIC -ATION IN MULTIMODAL MEDICAL IMAGEING,"INFORMATION SCIENCES 115, PP.261-279, 1999. 20. TSAO, E. C., BEZDEK, J. C., AND PAL, N. R., "FUZZY KOHONEN CLUSTERING NETWORKS," PATTER -N RECOGNITION, VOL. 27, NO. 5, PP. 757-764, 1994. 21. VANNIER, M. W., PILGRAM, T. K., SPEIDAL, C. M., NEUMANN, L. R.,RICKMAN, D. L., AND SCHE RTZ, L. D.,"VALIDATION OF MAGNETIC RESONANCE IMAGING (MRI) MULTISPECTRAL TISSUE CLASSIF -ICATION," COMPUTER MEDICAL IMAGING AND GRAPHICS, VOL. 15, PP. 217-223,1991. 22. YEN, J. AND LANGARI R., FUZZY LOGIC: INTELLIGENCE, CONTROL, AND INFORMATION, PRENTICE H -ALL, UPPER SADDLE RIVER, NEW JERSEY, 1999. 23.
HTTP://WWW.VGHTPE.GOV.TW/~NC/NRL/DISEASE_C.HTM 24.
HTTP://MEMBERS.TRIPOD.COM/TSUHUIHOSP/NEWS.HTM 25.
HTTP://WWW.GEOCITIES.COM/~DR_ERICLIN/CASES.HTM 台中澄清醫院腦神經外科教學資料 26. 吳智誠,私立大葉大學工業工程所碩士論文"資料探勘於影像資訊之應用-以乳房微鈣化特徵處理為例 "2001