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Chaotic Firefly Algorithm-Based Fuzzy C-Means Algorithm for Segmentation of Brain Tissues in Magnetic Resonance Images

Partha Ghosh[1], Kalyani Mali[2], Sitansu Kumar Das[3]

1. Assistant Professor, Department of Computer Sc. And Engineering, Govt. College of Engineering and Ceramic Technology, Kolkata, India.
2. Professor, Department of Computer Sc. And Engineering, University of Kalyani, Kalyani, India.
3. Assistant Professor, Department of Computer Science, Chittaranjan College, Kolkata, India.

Email: parth_ghos@rediffmail.com

ABSTRACT

Image segmentation with clustering approach is widely used in biomedical application. Accurate brain Magnetic Resonance (MR) image segmentation is a challenging task due to the complex anatomical structure of brain tissues in addition to the existence of intensity inhomogeneity, partial volume effects and noise. In this study, a spatial modified bias corrected FCM algorithm is applied to brain MRI for the purpose of segmentation into White Matter (WM), Gray Matter (GM) and Cerebrospinal fluid (CSF) in MR images. So to overcome the uncertainty caused by the above effects, a modified Fuzzy C-Means (*m*-FCM) algorithm for MR brain image segmentation is presented in this paper. Also FCM suffers from initialization sensitivity, to overcome this we have used chaos theory based firefly algorithm. This paper presents a novel application of FCM clustering by using Firefly algorithm with a chaotic map to initialize the population of fireflies and tune the absorption coefficient (λ), for increasing the global search mobility. This algorithm is called chaotic firefly integrated Fuzzy C- means (C-FAFCM) algorithm, which embeds chaos map in the Firefly Algorithm. The proposed technique is applied to several simulated and real T1-weighted for normal magnetic resonance brain images, taken from IBSR and BrainWeb database. The algorithm is realized by incorporating the spatial neighborhood information into the standard FCM algorithm and modifying the membership weighting of each cluster by regularizing it by Total Variation (TV) denoising. The experimental results on both simulated and real brain MRI datasets demonstrate that our proposed method (C-FAFCM) has satisfactory outputs in comparison with some other state of the art, based on FCM and non FCM based algorithms.