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A Hybrid Intelligent Approach for Image Segmentation and Feature Extraction Using Fuzzy Clustering, Lattice Boltzmann and GLDM Techniques

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Abstract

In this paper, novel Image Segmentation (IS) and feature extraction approaches based on Fuzzy Clustering (FC) and Lattice Boltzmann (LB) methods for segmentation step and Grey Level Difference Method (GLDM) method for feature extraction step are proposed. From the experimental results, the performance of our proposed method superior in terms of effectiveness and speed.

Keywords: Fuzzy Clustering; Image segmentation; Lattice Boltzmann; Feature extraction

1. Introduction

Over the past decades, Image Segmentation (IS) (Ahmadi, 2019b) has become more important because of its straight forward effects on the complexity and accuracy rate of the classification step (Ahmadi, 2019a, 2019b). Clustering is an Unsupervised Learning (UL) algorithm (Elhamifar & Vidal, 2013) that discover the general combinations which are related in data. The principal task of this method is to segment the unlabelled models. The models in the identical cluster are anticipated to have the most eminent correlations and the ones that are located between diverse clusters are anticipated to have the most differences. Therefore, the structure of the data which is shown by the clustering approach is assumed to display the actual data geometry more and more (Zhou et al., 2020). The principal difficulty of the clustering algorithm is affected by the appearance of the heterogeneous data. This kind of data includes manifold phases such as the variety of data, size of data, complex feature type and temporary viewpoints. Numerous approaches utilizing Kernel-based clustering have been introduced by Chen et al. (2011) and non-linear databases have been placed in high-dimensional feature domains to improve the possibility of linear separability in the other domain. The list of acronyms of this study is shown in Table 1.

Our contribution improves the current literature in multifarious directions. First, the participation of every property class to the clustering outcomes is accurately measured, and not inflicted arbitrarily. Second, the technique is performed immediately to the data, outwardly demanding a pre-processing. Third, our clustering approach is not limited to numeric and certain data. Fourth, we apply the LB approach and finally, we use the GLDM feature extraction method.

Table 1. List of acronyms.

Acronyms	Description
FC	Fuzzy Clustering
FCM	Fuzzy C-Means
LB	Lattice Boltzmann
GLDM	Grey Level Difference Method
IS	Image Segmentation
FS	Fuzzy Segmentation
FED	Fuzzy Edge Detection
MLPNN	Multi-Layer Perceptron Neural Network
RBFNN	Radial Basis Function Neural Network
ML	Machine Learning
ICA	Imperialist Competitive Algorithm
PSO	Particle Swarm Optimization
GA	Genetic Algorithm
GPU	Graphic Processing Unit
DE	Differential Evolution
BA	Bat Algorithm
MRI	Magnetic Resonance Imaging
KFECSB	Kernelized Fuzzy Entropy Clustering with Local Spatial Information and Bias Correction
PAM	Partitioning Around Medoid
UL	Unsupervised Learning
IP	Image Processing
MLPNN	Multi-Layer Perceptron Neural Network
ICA	Imperialist Competitive Algorithm
PDF	Probability Density Function
HCM	Hard C-Means

The rest of this paper is organized as follows. In Section 2, we review multiple literature reviews. In Section 3, the