Chapter 6
Landcover Change Detection Using PSO-Evaluated Quantum CA Approach on Multi-Temporal Remote-Sensing Watershed Images

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ABSTRACT

Computer science plays a major role in image segmentation and image processing applications. Despite the computational cost, PSO evaluated QCA approaches perform comparable to or better than their crisp counterparts. This novel approach, proposed in this chapter, has been found to enhance the functionality of the CA rule base and thus enhance the established potentiality of the fuzzy-based segmentation domain with the help of quantum cellular automata. This new unsupervised method is able to detect clusters using 2-dimensional quantum cellular automata model based on PSO evaluation. As a discrete, dynamical system, cellular automaton explores uniformly interconnected cells with states. In the second phase, it utilizes a 2-dimensional cellular automata to prioritize allocations of mixed pixels among overlapping land cover areas. The authors experiment on Tilaya Reservoir Catchment on Barakar River. The clustered regions are compared with well-known PSO, FCM, and k-means methods and also with the ground truth knowledge. The results show the superiority of the new method.

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INTRODUCTION

There is no universal approach on image segmentation as yet that performs uniformly well on all types of images. This is primarily because image segmentation is subjective and suffers from uncertainty. They are strongly application-dependent, in other words, there are no general algorithms vis-à-vis color spaces that are uniformly good for all color images. Pixel classification of watershed satellite image is a challenging task in remote sensing. Uses of Particle swarm Optimisation and Cellular Automata are significant methods in watershed image segmentation. This paper proposes a method of pixel classification using a new hybrid Particle Swarm Optimization- Quantum Cellular automata approach. The proposed unsupervised method identifies clusters using 2-Dimensional Cellular Automata model over particle swarm optimization. PSO is an optimization stochastic method based on populations, following the social behaviour like bird flocks. This new method identifies vague clusters utilizing initial fuzzy membership values. Cellular Automata is a dynamic and discrete model comprises of inter-connected cells uniform with states. We utilize 2D cellular automata method on Barakar river catchment area. The segmented regions are compared with existing methods, which shows superiority of our new method. Quantum CA theory provides us with a suitable tool that can represent the uncertainties arising in image segmentation and can model water image analysis of Tilaya catchment of Barakar river by quantum CA approach.

Introducing Remote sensing by Cogalton and Green in 1999 to be a method for obtaining knowledge of any object with no direct physical contact on it. For grouping pixels among predefined classes, a vast set of approaches exists (like turbid water or an urban area) in satellite images.

Remote sensing to interpret features for considering geospatial data, objects and classes on Earth's surface is a method without actual contact with it. There exists canopy of methods for segmenting pixels (for example, turbid water or an urban area) in remote sensing images.

Clustering, the unsupervised classification method, is based on maximum intra-class similarity and minimum inter-class similarity. Particle swarm optimisation method is used to experiment the state-of-the-art clustering methods for pixel classification in remote sensing images. To explore the best position in the search space, PSO, a population-based optimization algorithm is explored. In PSO, a particle which is called individual moves in direction of its own best previous position stochastically and the whole swarm's best previous position. A Rastrigrin function based PSO, initial decision rule generation, is proposed by us to predict pixel classification of remote sensing imagery

Cellular automaton, a uniformly interconnected cell, are a discrete, dynamical system composed of very simple well-known method to detect states in cellular spaces.

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