Chapter 12
Hybridization of Biogeography-Based Optimization and Gravitational Search Algorithm for Efficient Face Recognition

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ABSTRACT

This chapter aims to apply a novel hybridized evolutionary algorithm to the application of face recognition. Biogeography-based optimization (BBO) has some element of randomness to it that apart from improving the feasibility of a solution could reduce it as well. In order to overcome this drawback, this chapter proposes a hybridization of BBO with gravitational search algorithm (GSA), another nature-inspired algorithm, by incorporating certain knowledge into BBO instead of the randomness. The migration procedure of BBO that migrates SIVs between solutions is done between solutions only if the migration would lead to the betterment of a solution. BBO-GSA algorithm is applied to face recognition with the LFW (labelled faces in the wild) and ORL datasets in order to test its efficiency. Experimental results show that the proposed BBO-GSA algorithm outperforms or is on par with some of the nature-inspired techniques that have been applied to face recognition so far by achieving a recognition rate of 80% with the LFW dataset and 99.75% with the ORL dataset.

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INTRODUCTION

The history of Automatic Face Recognition dates back to the 1960s (Huang et al, 2007). From then on it has emerged as one of the most extensively studied research topics in computer vision due to its vast application in security systems for surveillance and authentication as it is more robust and secure as compared to other biometric techniques. Several mechanisms have been applied to recognize human faces automatically the most prevalent of which is the Principal Component Analysis (PCA) using Eigen faces (Eigen vectors). PCA is used for dimensionality reduction and feature selection purposes in this work. Another category of algorithms that are widely being applied to Face Recognition includes the nature inspired algorithmic techniques. These algorithms optimize a function by iteratively improving candidate solutions with regard to a given measure of quality or fitness function. Ant Colony Optimization (ACO), Biogeography-Based Optimization (BBO), Genetic Algorithm (GA), Gravitational Search Algorithm (GSA), Neural Networks (NN), Particle Swarm Optimization (PSO) are some among the many nature inspired algorithmic techniques that have been applied to face recognition so far (Dorigo, 2005).

Biogeography-Based Optimization and Gravitational Search Algorithm are relatively new optimization techniques. Biogeography-Based Optimization performs two major operations, they are, migration and mutation. The steps of these two operations include some randomness that apart from making a solution better might lead to it becoming poorer than what it was before as well. This leads to the generation of several infeasible solutions and also delays the convergence of the algorithm. If the replacement of SIVs is done in such a manner that poor SIVs are replaced with good SIVs only, BBO will converge to the optimal solution faster. It might also result in faster generation of better solutions. This work aims to overcome this drawback of BBO by borrowing certain characteristics of the GSA thus leading to a hybridized BBO-GSA algorithm. The hybridized BBO-GSA algorithm is applied to the problem of face recognition by optimizing the Eigen-faces generated by PCA and then a Support Vector Machine (SVM) Classifier is used to classify the faces into different classes.

The organization of the rest of this chapter is as follows, Section 2 provides a brief idea of the related work done in nature inspired algorithms with respect to face recognition, Section 3 provides a review of the major techniques used in this work such as PCA, BBO and GSA, Section 4 explains the BBO-GSA technique proposed in this chapter and its application to face recognition, Section 5 gives the experimental results of this work, Section 6 compares this work with some of the existing approaches to face recognition and Section 7 gives the conclusion and directions for future work.
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