Abstract

Existing soft computing methodologies applied for the segmentation of multilevel and color images are jeopardized in several respects. The most notable among them is the selection of the class levels/transition levels of the different segments/classes. Researches in this direction are aimed at finding suitable solutions to these problems.

In this thesis, an effort has been made to remove the aforementioned shortcomings of these soft computing methodologies involving neural network architectures, with special reference to the neighborhood topology-based multilayer self organizing neural network (MLSONN) architecture through an optimization of the class levels/transition levels of the segments/classes.

The initial steps in this direction are centered on the standard multilevel sigmoidal (MUSIG) activation function of the MLSONN architecture. This results in an induction of the data heterogeneity in the area of clustering/segmentation with the help of the conventional self organizing neural network. The MUSIG activation function uses equal and fixed class responses, assuming the homogeneity of image information content. The resultant genetic algorithm based optimized MUSIG (OptiMUSIG) activation function enables the network architecture to incorporate the underneath image content for the segmentation of the multilevel gray scale images.

Suitable extensions to the OptiMUSIG activation function with the help of the MLSONN architecture for the purpose of segmentation of true color images have been proposed by resorting to a parallel version of the activation function. The genetic algorithm based parallel version of optimized MUSIG (ParaOptiMUSIG) activation function is generated with the optimized class boundaries for the color components and is able to segment color images efficiently with the help of the parallel self-organizing neural network (PSONN) architecture.

Thirdly, in order to overcome the flaws of single objective based optimization procedures multi objective based optimization procedures have been invested to solve the problem of image segmentation. A multiobjective based OptiMUSIG activation function has been presented to segment the multilevel gray scale images. This refining procedure reduces the possibility of the non-effectiveness of a particular solution in the field of other objective functions. Not only restricted in this, a NSGA II based OptiMUSIG activation function is also presented to segment the multilevel gray scale images.

In attempt to put forward the aforementioned approaches together, multiobjective genetic algorithm based ParaOptiMUSIG activation function, which obviates the shortcomings of the single objective based ParaOptiMUSIG activation function, is proposed to segment color images. Similar to the NSGA II based Op-
tiMUSIG activation function, a NSGA II based ParaOptiMUSIG activation function is presented for the segmentation of true color images.

A segmentation procedure with a predefined number of classes cannot assure good results. Good segmented output may be derived by increasing or decreasing the number of classes if the exact number of classes in that test image/dataset is unknown. This is when no a priori knowledge regarding the information distribution, the number of classes and the information about the class responses are supplied at the preliminary stage. In this direction a genetic algorithm based clustering algorithm is presented to perform automatic clustering/segmentation. The effectiveness of a cluster/segment is validated by a proposed fuzzy intercluster hostility index. The proposed segmentation process starts from a large number of classes and finds out the exact number of classes in the test image/dataset.