

Chapter 17

A Novel Fuzzy Rule Guided Intelligent Technique for Gray Image Extraction and Segmentation

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ABSTRACT

Image segmentation and subsequent extraction from a noise-affected background, has all along remained a challenging task in the field of image processing. There are various methods reported in the literature to this effect. These methods include various Artificial Neural Network (ANN) models (primarily supervised in nature), Genetic Algorithm (GA) based techniques, intensity histogram based methods, et cetera. Providing an extraction solution working in unsupervised mode happens to be even more interesting a problem. Fuzzy systems concern fundamental methodology to represent and process uncertainty and imprecision in the linguistic information. The fuzzy systems that use fuzzy rules to represent the domain knowledge of the problem are known as Fuzzy Rule Base Systems (FRBS). Literature suggests that effort in this respect appears to be quite rudimentary. This chapter proposes a fuzzy rule guided novel technique that is functional devoid of any external intervention during execution. Experimental results suggest that this approach is an efficient one in comparison to different other techniques extensively addressed in literature. In order to justify the supremacy of performance of our proposed technique in respect of its competitors, the author takes recourse to effective metrics like Mean Squared Error (MSE), Mean Absolute Error (MAE), and Peak Signal to Noise Ratio (PSNR).

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INTRODUCTION

In traditional computing methodology, the prime considerations are precision, certainty, and rigor. By contrast, in soft computing the principal notion is that precision and certainty carry a cost and that computation, reasoning, and decision-making should exploit, according to possibility, the tolerance for imprecision, uncertainty, approximate reasoning, and partial truth for obtaining low-cost solutions. This leads to the remarkable human ability of understanding distorted speech, deciphering sloppy handwriting, comprehending the nuances of natural language, summarizing text, recognizing and classifying images, driving a vehicle in dense traffic and, more generally, making rational decisions in an environment of uncertainty and imprecision. The challenge, then, is to exploit the tolerance for imprecision by devising methods of computation that lead to an acceptable solution at low cost. This, in essence, is the guiding principle of soft computing (Zadeh et al, 1994). Soft computing is a consortium of methodologies that works synergetically and provides in one form or flexible information processing capability for handling real life ambiguous situations. Its aim is to exploit the tolerance for imprecision, uncertainty, approximate reasoning, and partial truth in order to achieve tractability, robustness, and low-cost solutions. The guiding principle is to devise methods of computation that lead to an acceptable solution at low cost by seeking for an approximate solution to an imprecisely/precisely formulated problem. In past few decades, Fuzzy Logic, one principal component of soft computing, has been used in a wide range of problem domains. Fuzzy logic provides an inference morphology that enables approximate human reasoning capabilities to be applied to knowledge-based systems. The theory of fuzzy logic (Zadeh et al., 1965) provides a mathematical strength to capture the uncertainties associated with human cognitive processes, such as thinking and reasoning. The conventional approaches

to knowledge representation lack the means for representing the meaning of fuzzy concepts. As a consequence, the approaches based on first order logic and classical probability theory do not provide an appropriate conceptual framework for dealing with the representation of commonsense knowledge, since such knowledge is by its nature both lexically imprecise and non-categorical. Fuzzy Logic is usually regarded as a formal way to describe how human beings perceive everyday concepts. In Fuzzy Image processing, fuzzy set theory (Zadeh et al., 1973) is applied to the task of image processing. Fuzzy Image Processing depends upon membership values (Zadeh et al., 1968), rule-base and inference engine. According to (Bezdek et al., 1999) fuzzy approaches for image segmentation can be categorized into four classes: segmentation via thresholding, segmentation via clustering, supervised segmentation and rule based segmentation. Among these categories, rule based segmentation are able to take advantage of application dependent heuristic knowledge and model them in the form of fuzzy rule base. In my case, the heuristic knowledge gathers by the process of already exists threshold segmentation methods that helped us to build the rule base. Feature extraction is the process of generating features to be used in the selection and classification tasks. Feature selection reduces the number of features provided to the classification task. Those features that are likely to assist in discrimination are selected and used in the classification task. Features that are not selected are discarded (Fu et al., 1981). After the features are extracted, a suitable classifier must be chosen. A number of classifiers are used and each classifier is found suitable to classify a particular kind of feature vectors depending upon their characteristics. The classifier used commonly is Nearest Neighbor classifier. The nearest neighbor classifier is used to compare the feature vector of the prototype with image feature vectors stored in the database. High-level feature extraction concerns finding shapes in computer images. To be able to recognize

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