Abstract

Segmenting an image into meaningful regions and extracting a set of features to represent the basic properties associated with each of the these segments are extremely important stages in a machine vision system. Segmented regions need not be crisp and mutually exclusive in many situations, rather, a fuzzy segmented description has been found to be sufficient and more appropriate. This thesis discusses the issues associated with extraction, selection and classification of patterns derived out of images to obtain a fuzzy segmented description. It aims at unveiling the problems prevailing in the field, introducing consistent notions and definitions, reviewing the current solutions and proposing novel methods to improve the scenario.

To do this, fuzzy segmentation is formally defined and is considered as an optimisation of an appropriate objective in a suitable feature space. In this case, the fundamental issues turn out to be the choice and identification of appropriate features and classifiers.

Segmentation has been attempted using gray-value alone as the feature in the form of fuzzy thresholding. The proposed fuzzy thresholding schemes can segment images with reasonably large imbalance in size and scatter of object and background gray-distributions. For the segmentation of 2D and 3D patterns, position vectors of the pixels have been found to be satisfactory features. A new fuzzy clustering algorithm has been proposed for this purpose. In a more general situation, features are to be derived out of the primary measurements for proper classification of the pixels. A procedure for evaluation of the features has been proposed to identify their relevance for demarcation of regions with diverse characteristics. The notions of fuzzy histograms and fuzzy co-occurrences have been introduced to demonstrate the superiority of fuzzy notions for the feature extraction.

Conventional clustering schemes are found to be sensitive to the size of the regions and the scatter of the feature distributions. Also these algorithms identify only hyperspherical clusters. A new fuzzy clustering algorithm has been introduced to detect clusters of distinct geometrical nature. Problems associated with the segmentation of porous 3D surfaces has been raised in this thesis. A possible solution to this, with the help of fuzzy c-distinct structures algorithm, has been proposed. Proposed algorithms have been verified on a number of 2D, 3D, tonal, textural, synthetic and natural scenes.

Key Words – Segmentation, Fuzzy Sets, Pattern Classification, Feature Selection, Fuzzy Clustering, Texture, Range Image, Gray-level Statistics.