ABSTRACT

The thesis is concerned with developing unified model-based techniques for the three basic problems of image analysis, namely, segmentation, shape description, and texture description.

Segmentation of a noisy digitized image may be stated as the classification of the pixels comprising the image into domain (region) points and boundary (edge) points. The problem is treated as a classification problem into classes comprising different types of edges and regions. A framework to represent these classes is established so that a unified approach for edge detection and region growing can be considered simultaneously. A two-stage algorithm is developed on this framework. The first stage classifies the pixels on a qualitative basis and the second stage classifies on a quantitative basis. An exact statistic to perform the requisite test in the second stage is derived. Two illustrations of this algorithm are presented.

For the shape description problem, time series modelling techniques are adapted here to represent or describe two-dimensional closed contours. Both linear and nonlinear models are fitted. It is found that to detect small changes in shape nonlinear modelling is necessary, even though linear models may be sufficient to differentiate between shapes which differ widely. A nonlinear model called the Non-Causal Quadratic Volterra model is developed

here for the purpose.

To describe textural regions of digital images, a technique for identification of the autoregressive components is developed for a general class of two-dimensional autoregressive model. Examples with synthetic textures are presented to illustrate that the model identification is appropriate.

Since for such modelling of shape and textural domains the feature spaces for different classes are different, a classifier and a recognition scheme using the parameters of such model are presented. The classification and recognition scheme are illustrated with shapes of aircrafts and with real periodic and aperiodic textures.

KEY WORDS: IMAGE ANALYSIS, SEGMENTATION, SHAPE DESCRIPTION, TEXTURE DESCRIPTION, CLASSIFICATION, RECOGNITION.