SUMMARY

Image coding is a process which produces an image identical to the original one in the sense of quality and intelligibility, but occupies less space. The goal of this dissertation is to produce an algorithm, which we call image compression based on “centipede” model, for lossy-coding of an image in the way that edges, contrast and scale through edges are utilized to produce a powerful and sparse representation of the image. Edges detected by using generalized edge detector (GED) constitute very sparse information. It has been shown that edge brightness and contrast calculated through edge segments are not adequate to produce a reliable and precise representation. The proposed algorithm produces a contour code which consists of position, brightness, contrast and an estimate of the scale in the form of *width* for each edge element in the image. The segments obtained by tracing connected edge elements are sorted with respect to weighted sum of their length, mean contrast, deviation and curvature. The edges are then thresholded to eliminate some of which has less priority in this order. Coding of all these parameters is a bit-consuming operation. Since they change smoothly in a small neighborhood, they can be approximated by polynomials, then the coefficients of the polynomials are coded. Edge locations are coded by constructing differential chain code followed by Huffman coding and starting points are coded in the form of difference between lexicographically ordered points. A reliable approximation to the original image from the sparse information is obtained via solving the hybrid energy functional which spans $\lambda\tau$-space, where λ represents the smoothness of the image and τ represents the continuity of the image.

The proposed model and the algorithm has been tested on both real and synthetic images. Compression ratio is up to 180:1 for synthetic images and 10:1-100:1 for real images. Reconstructed images are evaluated both quantitatively with NMSE (normalized mean square error), SNR (signal-to-noise ratio) and PSNR (peak-to-peak SNR) and qualitatively with visual appearance of artifacts. We have experimentally shown that the proposed model preserves perceptually important features even at the high compression ratios.