INFORMATION RETRIEVAL FROM IMAGES DEGRADED BY FILM GRAIN NOISE

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CERTIFICATE

This is to certify that the dissertation, "Information Retrieval from Images Degraded by Film Grain Noise," which is being submitted by Anil Shrinivas Tavildar for the award of the degree of Doctor of Philosophy to the Indian Institute of Technology, New Delhi, is a record of bonafide research work.

This dissertation has reached the standard fulfilling the requirements of regulations relating to the degree. The results obtained in this dissertation have not been submitted to any other University or Institute for the award of any degree or diploma.

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ABSTRACT

Digital image processing has acquired a high degree of importance due to its applications in many diverse fields. The image is commonly recorded on a photographic film. The information retrieval is affected by various factors like the random noise, the system nonlinearities, the blurring effects etc. during the recording and the scanning of images.

Any developed photographic film shows a random grainy appearance which constitutes film grain noise. The thesis presents results of studies on information retrieval from photographic images in the presence of film grain noise. The information retrieval techniques are based on decision theoretic concepts.

An existing model of film grain noise has been modified to include the effect of grain clustering. Binary detection strategies have been developed for films with and without grain clustering. A developed film is scanned using a top-hat square aperture. It is assumed to be positioned exactly over one pixel at a time. Blurring degradations have not been considered.

The detection strategy is based on multiple observations. For films without grain clustering, the analysis is applicable for the entire range of signal dependency parameter. It has been shown that the use of decision theoretic concepts leads to a superior strategy as compared to that with the ad-hoc threshold.

The effect of the light scattering in the emulsion has been considered as a source of intersymbol interference and the binary

detection has also been studied in the presence of film grain noise and ISI. The performance has been evaluated for two films.

The detection strategy has been used for retrieval of information from the low contrast soft-tissue binary X-ray images in the presence of film grain noise. It has been shown that the strategy based on multiple samples results in a significant increase in the probability of detection or true positive identification of the malignant tissues.

The MAP estimation algorithms have been proposed for images with continuously varying grey levels. Considering the large computational effort involved in the implementation of the MAP algorithms, a signal independent transformation has been developed when the signal dependency parameter, equals 1/3. The MAP algorithm has been modified using the proposed SIT. The performance has been evaluated in terms of the normalized mean square error and the efficiency of various estimation algorithms has been discussed.

Linear mean square error (LMSE) filters (Wiener filters) have been developed considering the film grain noise to be signal independent multiplicative noise in the intensity domain. The mean square error has been evaluated for binary and multilevel images by assuming the signal spectra corresponding to Laplacian autocorrelation function and gaussian spectra respectively. The effect of the varying noise-to-signal bandwidth ratio has been examined.

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