FUZZY MULTIMODAL SEGMENTATION

An application to planetary images

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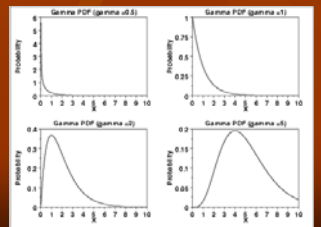
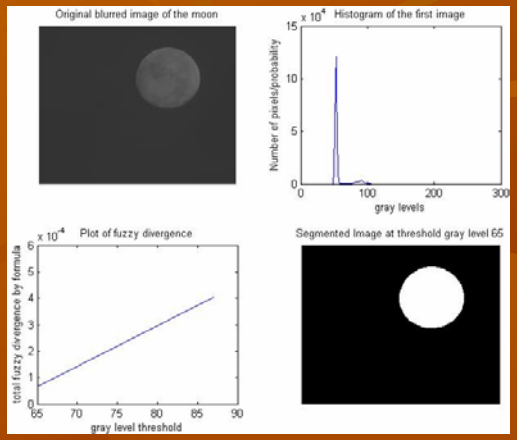
ABSTRACT

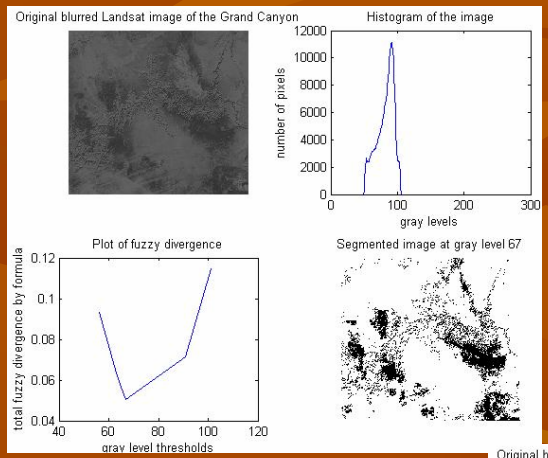
A new image thresholding method using fuzzy divergence has been proposed here. Gamma distribution has been chosen as the membership function. The technique minimizes the fuzzy divergence or the separation between the actual and the ideal thresholded image.

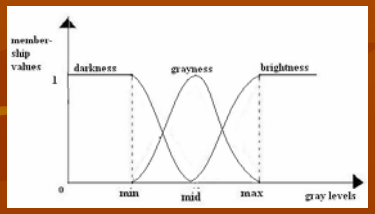
METHODOLOGY

The valleys of the histogram are selected, each a prospective threshold. Divergence of each pixel has been found out and added. Minimum divergence means that maximum belonging of pixels to the object region and pixels to the belonging region, that is the thresholded image is almost towards the ideally segmented image. Minimum divergence is selected and the corresponding gray level is the optimum threshold.









FUTURE WORK

- Usage of different classes of membership other than the skewed gamma distribution for belongingness.
- Comparison of various types of fuzzy entropy divergence funtions to differentiate images.
- Optimize the number of thresholds for a given image and resoltuion.

FORMULATION FLOWCHART

$\mu_0 = \frac{\sum_{f=0}^{t} f\,count(f)}{\sum_{f=0}^{t} count(f)}$, $\mu_1 = \frac{\sum_{f=t+1}^{L-1} f\,count(f)}{\sum_{f=t+1}^{L-1} count(f)}$, where μ_0, μ_1 are average g-levels of object and background respectively, f a g-level and t the chosen threshold.

From the theory of standard gamma distribution, membership of a certain gray level to the object-background distribution scheme is $\mu(f(i,j)) = \exp(-const.(x-\mu_0))$ if $f \le t$

$= \exp(-const.(x-\mu_1))$ if $f > t$

Similar memberships can be established for multimodal thresholding too.

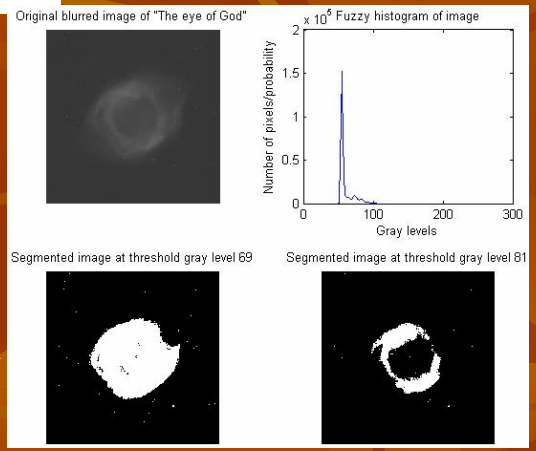
Total Fuzzy divergence between two images, A and B, can be derived from Shannon's entropy and finally written as :

$$\sum_{i=0}^{M-1}\sum_{j=0}^{M-1}(2-(1-\mu_A(x_{ij})+\mu_B(x_{ij}))e^{\mu_A(x_{ij})-\mu_B(x_{ij})} - (1-\mu_B(x_{ij})+\mu_A(x_{ij}))e^{(\mu_B(x_{ij})-\mu_A(x_{ij}))})$$

BASIC DEFINITIONS

- Fuzzy histogram is used instead of a normal histogram. A membership slope is decided (n=3 in this case) and the probability of occurance of any gray level is influenced by its neighboring gray levels, in weght of the slope.
- Gamma distribution is given as :

- Standard gamma distribution imples $\mu = 0$, $\beta = 1$, i.e. standard gamma distribution.
- Shannon information theory is used to determine the funny entropy of an image.



REFERENCES

Chaira,T., Ray, A.K., Segmentation using fuzzy divergence, Pattern Recognition Letters, Vol 24 Issue 12, 2003

Fan ,J. ,Xie, W,1999, distance measure and induced fuzzy entropy, Fuzzy Sets and System 104

Pal,N.R.,Pal, S.K.,1991,Entropy, a new definition and its application, IEEE System Man and Cybernet