NON-HOMOGENOUS AUTO-REGRESSIVE MODEL BASED PRIOR FOR MULTIRESOLUTION FUSION

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1. ABSTRACT

In this paper we propose a model-based approach for multiresolution fusion of remotely sensed images. Given a high spatial resolution & low spectral resolution PAN (Panchromatic) image and a low spatial resolution & high spectral resolution MS (Multispectral) images of the same geographical area, the objective is to enhance the spatial resolution of the MS images to that of the PAN image i.e. to obtain a high spatial and spectral resolution images. A proper regularization technique is required to address this ill posed problem and get a better solution. We use a non-homogenous AR (auto-regressive) model based prior for each of the fused MS images. This method is insensitive to registration errors between PAN and MS images unlike other methods. The AR parameters are estimated using the segmented regions of the PAN image. The estimated AR parameters are then used in minimizing the cost function. Experimental results are illustrated for Landsat-7 data set.

2. INTRODUCTION & PROBLEM STATEMENT

Obtaining remotely sensed images with high spatial and spectral resolutions from a satellite is a difficult task due to hardware and technological limitations. Multiresolution fusion is a process which is used to obtain images with high spectral and spatial resolution [1]. Generally MS images are captured with a low spatial resolution than the PAN image but with a high spectral resolution in order to get an acceptable signal-to-noise ratio in the captured data. Due to this physical constraint involving a trade-off between spatial and spectral resolutions, a great amount of research is being carried out in this field of multiresolution fusion. There have been many methods developed such as the Intensity-hue-saturation (IHS) transform technique [2], wavelet transform technique [3], contourlet wavelet based approach [4] to address the problem of Multiresolution fusion for remote-sensing applications.

In this paper, we extend the model-based approach for multiresolution fusion proposed in [5]. Here the authors use a homogenous AR model for the MS images and obtain the AR parameters from the PAN image in order to learn the spatial dependency in the fused MS images. A total of 24 AR parameters are estimated considering homogenous AR model for the PAN image. In practice a real satellite image can seldom be represented by homogenous models as they are made up of different textures with high frequency regions as well as constant areas. Hence the prior has to be chosen such that the prior parameter adapts to the local structure of the image yielding less noisy result in the homogenous areas, and also preserve the sharp details. This motivates us to choose non-homogenous AR model for the MS images and learn these parameters by using a non-homogenous AR model for the PAN image in order to obtain the fusion.

In the proposed method, we first segment the PAN image into a number of regions using GMM (Gaussian Mixture Model) based approach and obtain AR parameters of each region by using the AR model. With these set of parameters we enhance the spatial resolution of the MS images by regularization technique, thus obtaining high spatial and spectral resolution fused MS images.

3. BLOCK DIAGRAM OF THE PROPOSED PROCESS AND EXPERIMENTS

The proposed fusion process for the n^{th} low resolution MS image and the PAN image is illustrated by the Figure 1, the result being the fused MS image.

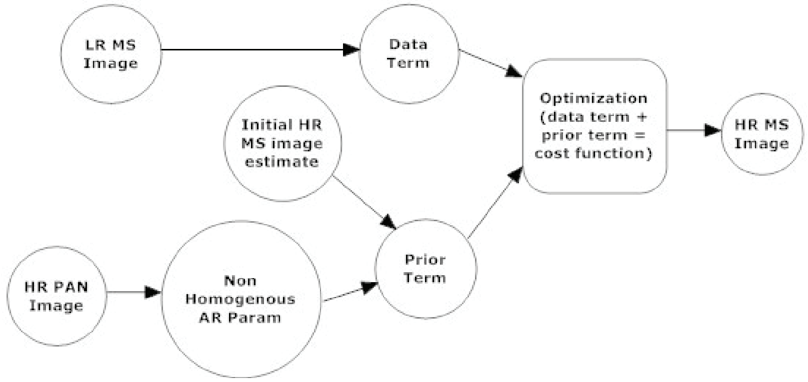
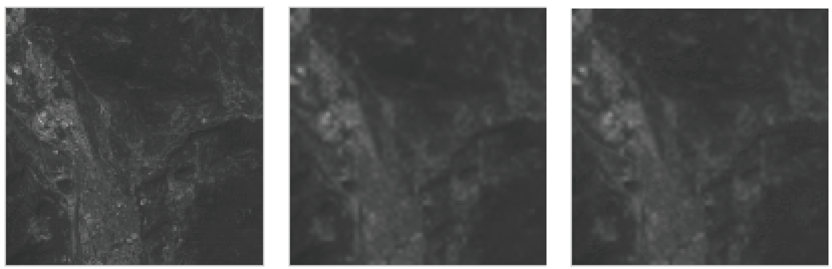


Fig. 1. Block diagram of multiresolution fusion process for a MS and a PAN image. LR and HR indicate low resolution and high resolution, respectively.



(a) (b) (c)

Fig. 2. Experiments conducted on degraded version of Landsat-7data set. (a) Original 128x128 HR MS image. (b) HR MS image using homogenous AR model prior. (c) HR MS image using non-homogenous AR model prior.

Although it is difficult to discern the differences perceptually in these small size images, the following quantitative comparison shows that the proposed method is better than the homogenous AR approach. The slight inferior performance in MSE index might be due to the approximation in choosing the number of segmented regions. But we obtain improvements in RASE and ERGAS.

Image	**MSE**	**RASE**	**ERGAS**
AR (Homogenous)	0.0041	0.4886	1.9545
AR (Non-Homogenous)	0.0046	0.4792	1.9170

Table.1: Quantitative assessment of the two AR model approaches

4. CONCLUSION

We proposed a non-homogenous AR model based approach for multiresolution fusion.

5. REFERENCES

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