



An Approach to Segmentation of Images with Intensity Inhomogeneity by Denoising and Bias Correction

Ms. Meghavati Mahajan¹, Prof. Dinesh D. Patil²

¹PG Student, Department of Computer Science and Engineering, Shri Sant Gadge Baba College of Engineering and Technology, Bhusawal, Maharashtra, India

²Associate Professor and Head, Department of Computer Science and Engineering, Shri Sant Gadge Baba College of Engineering and Technology, Bhusawal, Maharashtra, India

¹punam.n.mahajan@gmail.com; ²dineshonly@gmail.com

Abstract— *Magnetic Resonance Imaging, X-rays in other words radiography generated images used in medical diagnosis must be error free that is they should not content in additional noise which may lead to inaccurate analysis resultant in further consequences for patient, as medical equipments for MRIs factor intensity inhomogeneity which leads to involvement of bias field that has side effects. To provide an accurate diagnosis of disease is current need of medical field as it may or definitely increases chance of survival of human being. This paper aims at implementation of an approach to perform Segmentation of Images with Intensity Inhomogeneity by performing Denoising and Bias Correction.*

Keywords— *Segmentation, Bias Correction, MRI, intensity inhomogeneity, Computer vision.*

I. INTRODUCTION

Intensity inhomogeneity is generally attributed to a spatially varying field multiplying true signal of the same object in measured image. This spatially varying smooth field is named as bias field. Bias correction is a procedure to estimate the bias field from the measured image to reduce its side effect [5]. Existing bias correction approaches can be categorized into two categories, namely prospective [11]–[14] and retrospective [5], [6], [15]–[26] approaches. Prospective methods mainly aims at calibrating and improving image acquisition processing but these methods are unable to correct patient-induced inhomogeneity [10], [23]. On other hand comparatively, retrospective methods only rely on the acquired images and some prior knowledge they are relatively more generalized, and can be used to correct patient-induced inhomogeneity. They can be further categorized into several categories on basis of filtering [9], surface fitting [24], histogram [25], and segmentation [5], [6], [19]–[22], [27]. Among various retrospective methods, segmentation based ones are most attractive. The intensity inhomogeneity caused by imperfection of imaging devices and subject-induced susceptibility effects may result to some misclassifications by intensity-based segmentation algorithms [5]–[9]. Statistically, if we see misclassification is caused mainly due to prolonged tail of intensity distribution of each object, due to which it is difficult to extract each single object accurately based only on their intensities. Intensity inhomogeneity that exists in images generally obtained due to different modalities, like ultrasound, X-ray radiography/tomography, and also magnetic resonance imaging (MRI). Recently, Li et al. [6] proposed a parametric method for simultaneous bias field correction and segmentation by minimizing a least square energy

functional. The bias field is modelled as a linear combination of a set of orthogonal polynomial basis functions [20], [27].

II. RELATED WORK

Major challenge in image segmentation is presented generally by Intensity inhomogeneity, Mostly used image segmentation algorithms are region-based also they typically rely on homogeneity of image intensities in the region of interest, In [1] authors developed model for image segmentation with intensity inhomogeneity along with bias field estimation. They firstly defined a local intensity clustering criterion function. Then, the energy is minimized by using level set evolution process. To ensure that the active contours are smooth and eliminate any reinitialization of level set function in the evolution of the active contours regularization is used in level set process. In [2] authors, proposes a novel method for image segmentation that combines a region based artificial intelligence technique named fuzzy c-means (FCM) and also a boundary based mathematical modelling technique level set method. In this work, FCM method is used for obtaining initial contour for Level set Method. Final segmentation is achieved by use of Level set method for active control of contour. Adaptive PDE-based and new level set algorithm are most widely used image segmentation methods that depend on the uniformity of image intensities in the regions of interest, which often fail to provide accurate segmentation results due to the lack of homogeneity. In [4] author proposes a novel region-based method for image segmentation that deals with intensity in homogeneities.

III. PROPOSED SYSTEM

A. Problem statement

The main aim is to implement new approach for segmentation of images with intensity inhomogeneity by denoising and bias correction. Intensity inhomogeneity mainly is incurred due to images generated during medical diagnosis through machines such as MRI, Ultrasound, tomography, etc. The major factor is removal of factor so that accurate analysis of image can be done for that we first denoised image and afterwards apply bias correction to minimize bias field effect.

B. Proposed system workflow

- Step 1. Start
- Step 2. In GUI of main application window select any one option.
 - a. For Simple Image
 - i. When click on load image, file chooser appears select any simple image.
 - ii. Image chosen is rescaled.
 - iii. Denoised image using median filtering
 - iv. For segmentation results apply some morphological erode operation
 - v. At completion we get to see histogram of original and bias corrected image.
 - b. For MRI image
 - i. When click on load image, file chooser appears select any MRI image.
 - ii. Before segmentation, noise removal using filter option.
 - iii. Generate the bias field and bias corrected image
 - iv. So result of segmentation of images. Along with results and also histogram of original and bias corrected images.
- Step 3. Repeat the steps for other images else exit the application.

IV. EXPERIMENTS AND RESULTS

Proposed work is implemented in MATLAB, for experiment we consider two category of images, simple for regular images and for medical diagnosis we use images such X-ray, MRI and similar types. The segmentation tasks performed is with denoising and apply bias correction. Figure 1 shows the main GUI interface or the proposed system.

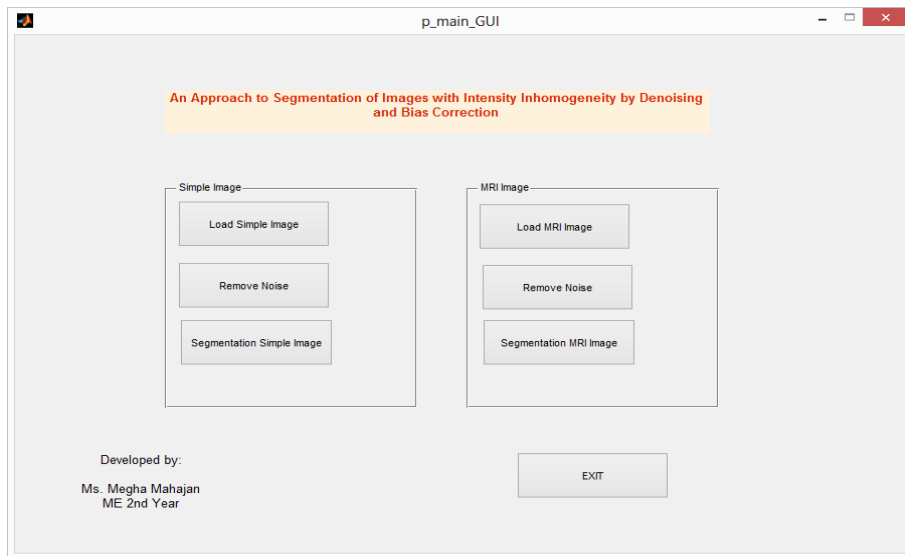
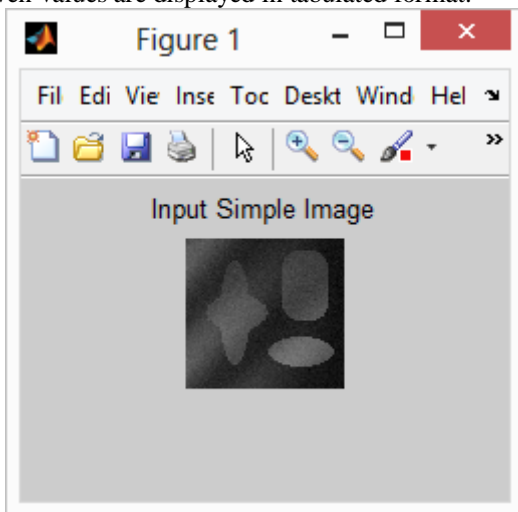
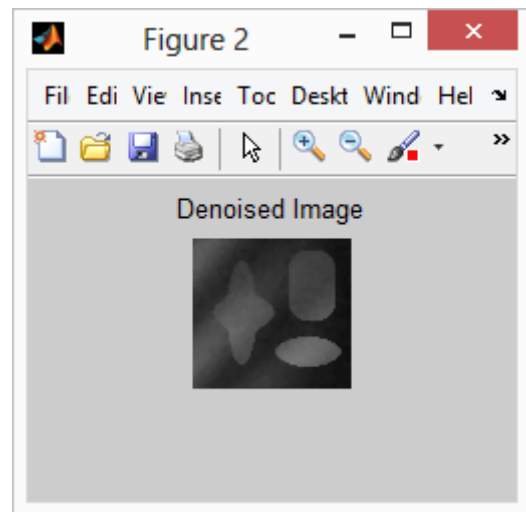


Fig. 1 main GUI of proposed system

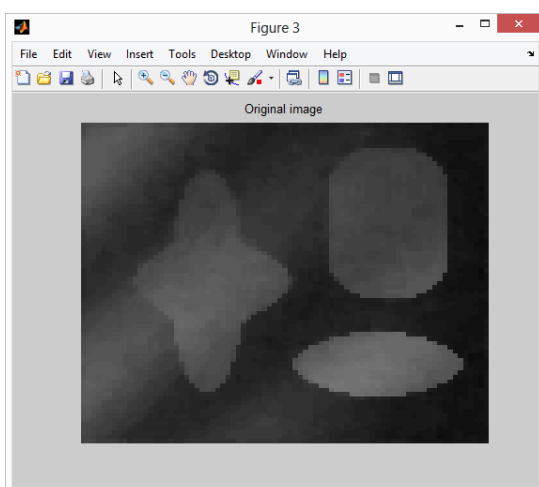
For category of simple images we image simple_image.jpg, when click on the other options the intermediate results are generated also with bias field corrected images, figure 2 (a) – (f) shows the complete set of results given values are displayed in tabulated format.



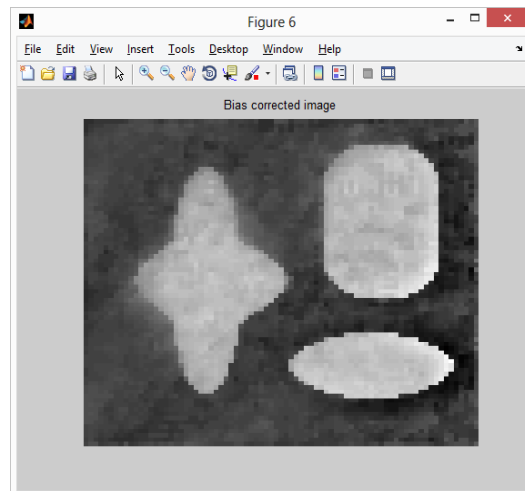
(a)



(b)



(c)



(d)

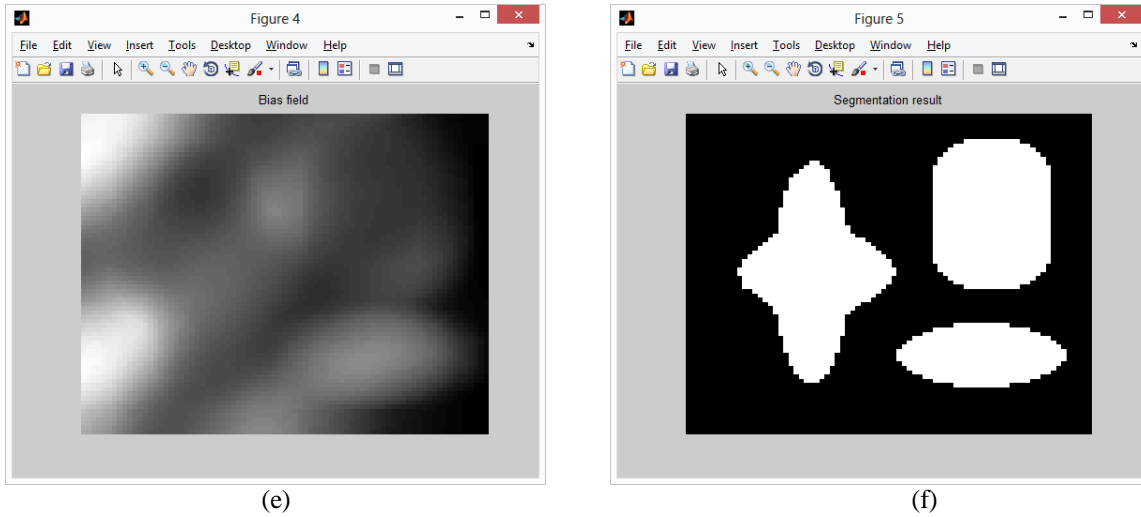


Fig. 2 (a) Input_simple_image.jpg (b) denoised image (c) Original image (d) bias corrected image (e) bias field application (f) segmentation after image correction.

The difference in histograms of original and bias corrected images after noise removal and bias correction, justifies the improvement in result where segmented image gets generated as shown in figure 3.

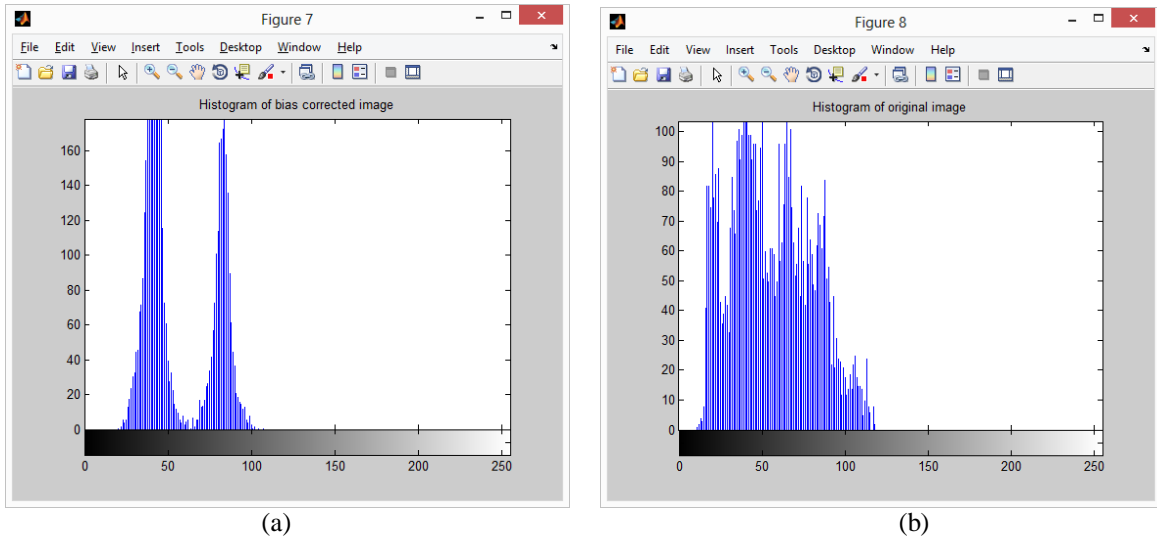
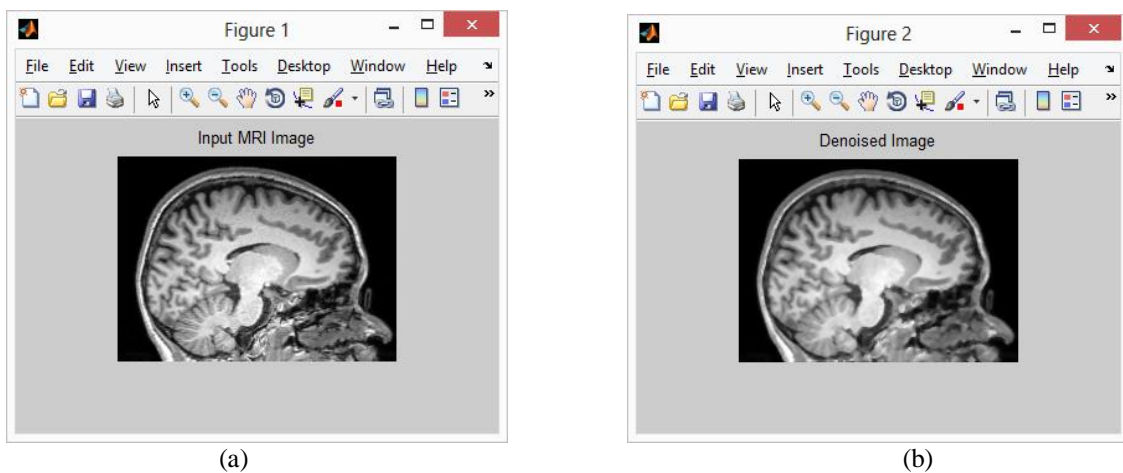
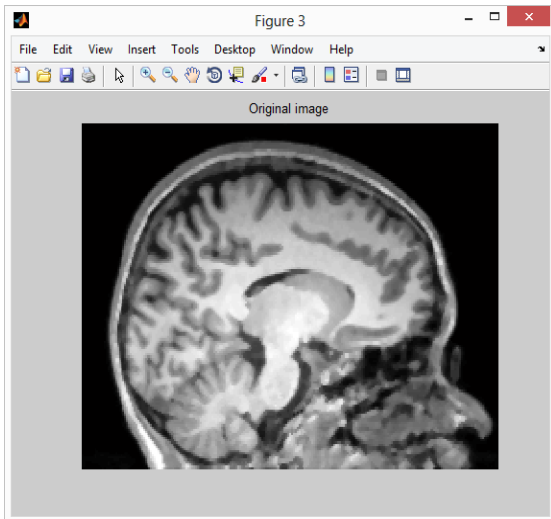


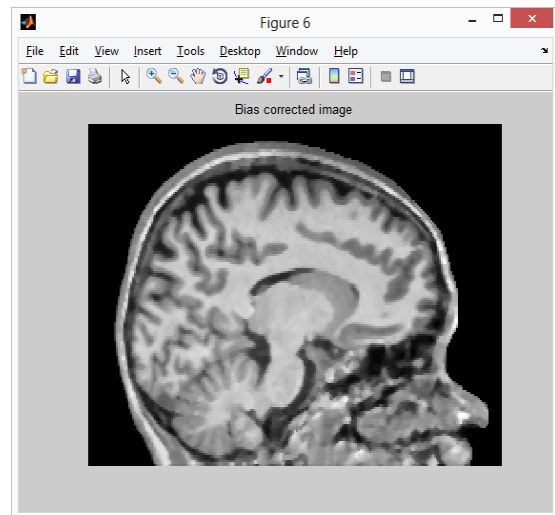
Fig. 3 (a) Histogram of Bias corrected simple_input.jpg image (b) Histogram of original image.

Figure 4 illustrates results generated for medical image that is a 3T MRI image when provided as an input and results obtained thereafter for the same.

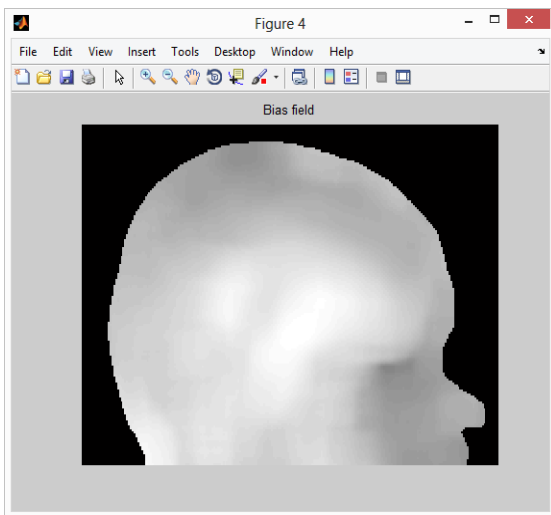




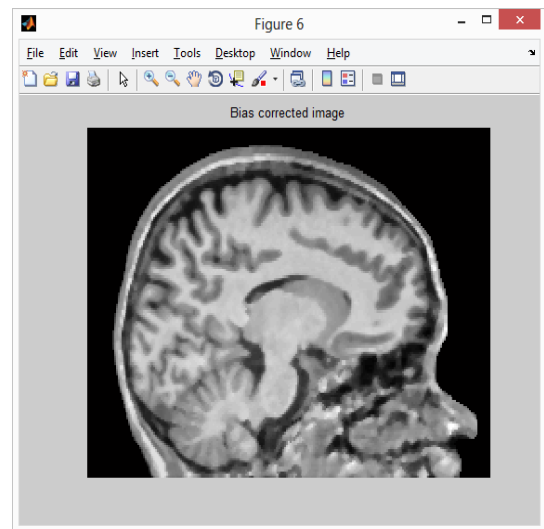
(d)



(e)



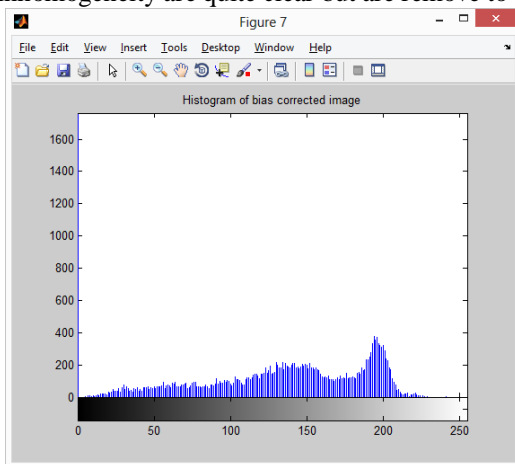
(e)



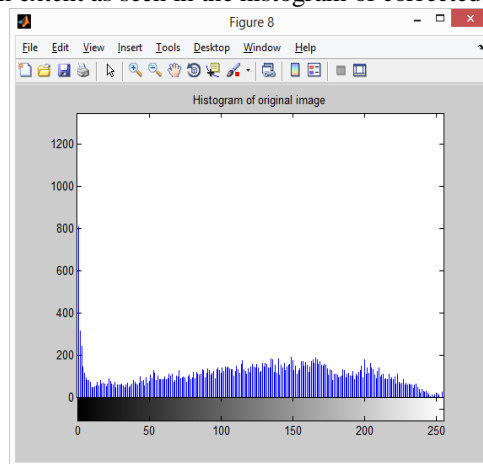
(f)

Fig. 4 (a) MRI_3T_brian_image.jpg (b) denoised image (c) Original image (d) bias corrected image (e) bias field application (f) segmentation after image correction.

Figure 5 illustrates the histogram of bias corrected and original image where the difference due to intensity inhomogeneity are quite clear but are remove to certain extent as seen in the histogram of corrected image.



(a)



(b)

Fig. 5 (a) Histogram of Bias corrected simple_input.jpg image (b) Histogram of original image.

The dataset used in standard dataset for computer vision and for medical images from brain on web dataset. The main aim of implemented system was removal of noise and factors of bias field and intensity inhomogeneity due to equipment used for medical image diagnosis. The results generated shows the better performance and definitely it shall improve the medical image analysis.

V. CONCLUSIONS

In this paper we have proposed and implemented an approach for segmentation of images with intensity inhomogeneity by denoising and bias correction, for experimentation images consider are simple and also MRI images one required for medical diagnosis, the importance of this work lies in its usefulness in medical analysis, as corrected images with noise removal and bias correction help in more accurate diagnosis. Generally in image analysis, the main drawback is generation of intensity inhomogeneity for which bias correction is required as it generally results in inaccurate diagnosis. Images generally obtained are due to different modalities, like ultrasound, X-ray radiography/tomography, and also magnetic resonance imaging (MRI). Implemented work has better performance than existing system which is shown by results obtained.

ACKNOWLEDGEMENT

We would like to articulate our profound gratitude and indebtedness to those persons who helped us in completion of the paper. First and foremost, we would like to convey our gratefulness our Principal Dr. R. P. Singh for his continuing support. We would like to dedicate this work our parents and would like to thank all the staff members from Department of Computer Science and Engineering, SSGBCOET Bhusawal Maharashtra. Also our special thanks to all the writers of reference paper that are referred by us.

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