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Local Image Registration by Adaptive Filtering Method

Bhavna B. Khajone[1]
Computer Science & Engineering Department
Sipna College of Engineering & Tech., In Front of Nemani Godown, Badnera Road, Amravati (MS) 444701

V. K. Shandilya[2]
Professor
Computer Science & Engineering Department
Sipna College of Engineering & Tech., In Front of Nemani Godown, Badnera Road, Amravati (MS) 444701

Abstract: Many image processing applications often require comparing or combining information provided by multiple images. Image matching and registration are the fundamental steps towards attainment of such tasks. The goal of image registration is to find corresponding functional locations in two or more images. It is used in many fields like computer vision, medical imaging, and remote sensing. It is required for combining information taken from different sensors (multi sensor registration), determining changes in images taken at different time (multi temporal registration), gathering three dimensional information from images where camera or the objects in the scene is moving (multi view registration) or scene to model registration. The primary aim of this work is to understand and implement concepts of image matching and registration technique using adaptive filtering method. Up till now there are several techniques for image registration; however it suffers from non uniform sampling which makes it not suitable for many applications in which the registered images are altered. So an adaptive filtering framework for local image registration is introduced for local image registration, which compensates for the effect of local distortions/displacements without explicitly estimating a distortion/displacement field. To this effect, local image registration is formulated as a two-dimensional (2-D) system identification problem with spatially varying system parameters. For this it utilizes a 2-D adaptive filtering framework to identify the locally varying system parameters. Experimental results demonstrate that the proposed 2-D adaptive filtering framework is very successful in modelling and compensation of both local distortions, such as Stirmark attacks, and local motion, such as in the presence of a parallax field. In particular, the proposed method can provide image registration to: a) Enable reliable detection of watermarks following a Stirmark attack in non-blind detection scenarios, b) Compensate for lens distortions, and c) Align multi-view images with nonparametric local motion. The entropy of an image, mean intensity, MSE, pSNR are used as the quality assessment parameters between transformed sensed image and registered image is been computed.

Keywords: Adaptive filtering, Image Registration, Local Image Registration, Mapping function, non-parametric image registration, Registration.

I. INTRODUCTION

Image registration is the process of aligning two or more images of the same scene captured from different angles /view points, at different times and by different camera. It is a crucial step in all image analysis tasks in which final information is gained from the registered image. It consist transformation which modifies an image so that it matches another one. Virtually all large systems which evaluate images require the registration of images, or a closely related operation, as an intermediate step. Specific examples of systems where image registration is a significant component include matching a target with a real-time image of a scene for target recognition, monitoring global land usage using satellite images, matching stereo images to recover shape for autonomous navigation, and aligning images from different medical modalities for diagnosis. Image registration sometimes called as image alignment. Its purpose is to overlay two or more images of the same scene taken at different times, from different viewpoints and/or by different sensors. It is a fundamental image processing technique and is very useful in integrating information from different sensors, finding changes in images taken at different times. Depending upon how the images which are to be registered are acquired, the image registration is classified into the four classes:

- Multi view image registration
- Multi temporal image registration
- Multi modal image registration
- Scene to model registration

Multi view image registration (different view points): Images of the same scene are acquired from different viewpoints. Our main aim is to gain larger a 2D view of the scene or a 3D representation of the scanned scene. Examples of applications: Remote sensing: mosaicing of images of the surveyed area. Computer vision: shape recovery.

Multi temporal image registration (different times): Images of the same scene are acquired at different times, often on regular basis, and possibly under different conditions. Here the images which are to be registered are always having the change in illumination because illumination will change as time changes. Our main aim is to find and evaluate changes in the scene which appeared between the consecutive images. Examples of applications: Remote sensing: monitoring of global land usage, planning of landscape. Computer vision: automatic change detection for security monitoring, motion tracking. Medical imaging: monitoring of the healing therapy, monitoring of the tumour growth.

Multimodal modal image registration (different sensors): Images of the same scene are acquired by different sensors. Here the care should be taken that each sensor works on the different frequency bands and hence they sensors the different bands of frequency. Our main aim is to integrate the information obtained from different source streams to gain more complex and detailed scene representation. Examples of applications: Remote sensing: fusion of information from sensors with different characteristics likes panchromatic images and multispectral images. Medical imaging: combination of sensors recording the anatomical body structure like magnetic resonance image (MRI), ultrasound or CT with sensors monitoring functional and metabolic body activities like positron emission tomography (PET), single photon emission computed tomography (SPECT) or magnetic resonance spectroscopy (MRS).

Scene to model registration: Images of a scene and a model of the scene are registered. The main difference of this type of registration is here we have one image and another model or map of that image instead of two images like in all above cases. The model can be a computer representation of the scene, for instance maps or digital elevation models (DEM) in GIS, the map showing the amount of vegetation of particular area, the same scene of the another patient with similar content, etc. Our main aim is to localize the acquired image in the scene/model and/or to compare them. Examples of applications: Remote sensing: registration of satellite data into maps or other GIS layers. Computer vision: target template matching with real-time images, automatic quality inspection. Medical imaging: comparison of the patient image with digital anatomical atlases, specimen classification.

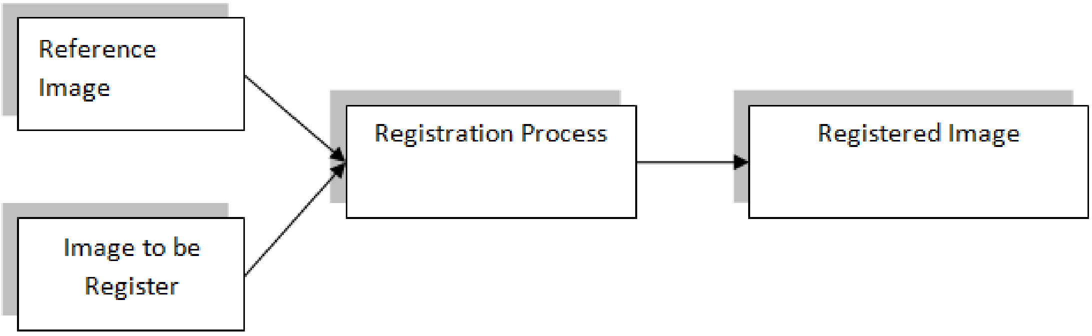

Fig 1: Block diagram of Image Registration.

II. Background Of Adaptive Filter

An adaptive filter is a computational device that iteratively models the relationship between the input and output signals of the filter. An adaptive filter self-adjusts the filter coefficients according to an adaptive algorithm. The following figure shows the diagram of a typical adaptive filter.

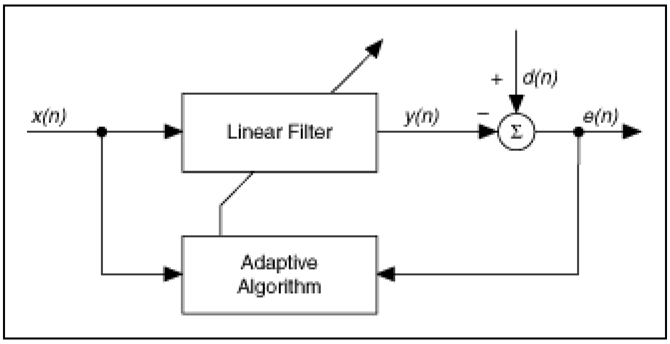

Fig 2: Adaptive filter.

Where,

x(n) is the input signal to the filter,

y(n) is the corresponding output signal,

d(n) is the additional input signal to the adaptive filter,

e(n) is the error signal that denotes difference between *d(n)* and *y(n).*

An adaptive filter is a computational device that attempts to model the relationship between two signals in real time in an iterative manner. An adaptive filter is defined by four aspects:

» The signals being processed by the filter.

» The structure that defines how the output signal of the filter is computed from its input signal.

» The parameters within this structure that can be iteratively changed to alter the filter's input-output relationship.

» The adaptive algorithm that describes how the parameters are adjusted from one time instant to the next.

An adaptive filter differs from a traditional digital filter in the following ways: (a) A traditional digital filter has only one input signal $x(n)$ and one output signal $y(n)$. An adaptive filter requires an additional input signal $d(n)$ and returns an additional output signal $e(n)$; (b) The filter coefficients of a traditional digital filter do not change over time. The coefficients of an adaptive filter change over time. Therefore, adaptive filters have a self-learning ability that traditional digital filters do not have.

a) Problem with Existing Image Registration Technique

Registration problem is to find reasonable transformation such that the transformed sensed image will look similar to reference image. Image registration plays a critically important role as a pre-processing step in many image processing and computer vision applications. A large number of techniques have been developed to solve different variants of this problem. One of the important factors to achieving accurately registered images is the model that describes the (spatial) mapping between the images to be registered. A frequent problem arises when images taken at different times, by different sensors or from different viewpoints need to be compared. The images need to be aligned with one another so that differences can be detected. A similar problem occurs when searching for a prototype or template in another image. To find the optimal match for the template in the image, the proper alignment between the image and template must be found. All of these problems, and many related variations, are solved by method that performs image registration.

b) Problem Statement

Image registration technique is also a classical problem and has been studied and developed for a long time. However, until now, it is still rare to find an accurate, robust, and automatic image registration method, and most existing image registration methods are designed for particular application, the performance of a methodology is always limited to a specific application, or sensor characteristics and the terrain characteristic of the imaged area. In terms of image registration, there are some problems with using current image registration techniques for high resolution images, namely: (a) precisely locating control points is not as simple as with moderate resolution images; (b) manually selecting the large number of control points required for precise registration is tedious and time consuming; and (c) high data volume will adversely affect the processing speed in the image registration.

c) Motivation for The Work

Registration problem is to find reasonable transformation such that the transformed sensed image will look similar to reference image. Medical image registration plays very important role in clinical applications including detection and diagnosis of disease, planning of therapy, guidance, follow up and monitoring of patients. The goal of this registration is to establish geometric correspondence between the two images such that the images can be compared and analyzed in a common frame. When the person is ill, he/she may not be in the position to stay steady while scanning is going on. It is very difficult for patient to be steady for several minutes, may be because of chronic pain. So as a result we may get rotated or translated image. To align the acquired image, image registration is required. For multimodal image registration, mutual information based algorithm will provide best results. When FOV is large, Image matching and registration will generate large panoramic images (mosaicing) from several overlapping images, producing super resolution images from multiple images of the same scene, change detection and multi sensor image fusion are the common tasks.

III. Adaptive Filtering Approach For Local Image Registration

The aim of the proposed Adaptive filtering method is to provide a solution to the problem of Local Image Registration for two main objectives: 1) Correction of locally varying image distortions, such as random bending attacks, e.g., Stirmark and spatially- varying lens distortions, and 2) Compensation of locally varying motions in the presence of a parallax field. In this system, we are going to present a local image registration technique based on adaptive filtering, for both space-varying distortion and motion compensation, which does not require explicit estimation of the local distortion/displacement field. For this Adaptive Filters have been successfully applied to a number of one-dimensional (1-D) system-identification problems, such as echo-cancellation. In this application, adaptive filters not only allow for the estimation of an unknown system but also incorporate the capability to track smoothly varying changes in the system. I map the 2-D image plane into a 1-D sequence using space-filling curves. This ensures spatial contiguity in the 2-D image plane, which is a prerequisite for filter convergence and tracking. The proposed method may be computationally simpler than other approaches for local image registration. For this purpose we have implemented the Least Means Square (LMS) adaption algorithm. The LMS algorithm is a linear adaptive filtering algorithm, which, in general, consists of two basic processes: 1) A filtering process, which involves, Computing the output of a linear filter in response to an input signal and Generating an estimation error by comparing this output with a desired response; (2) An adaptive process, which involves the automatic adjustment of the parameters of the filter in accordance with the estimation error. Following are the steps of the proposed adaptive filtering method:

Step 1: Read the input images, Reference Image and Target (Sensed) Image.

Step 2: Convert the RGB input image into grayscale.

Step 3: Align the images and Get the matching points (control points).

Step 4: Apply the Adaptive Filtering Method and then we get the final output which is Registered Image.

Step 5: Recover the RGB Registered Image.

Adaptive Local Image Registration is based on adaptive filtering frame work. Since Adaptive filters can estimate unknown systems and can track smooth changes in the system, this method register the images without the explicit estimation of the local displacement. This method can be used for both gray scale and colour images. Filter size plays an important role in the result of the Adaptive Local Image Registration. Filters of different size for different distortion angles in the same set of images are used to analyze the effects of filter size in the result of the Adaptive Local Image Registration.

IV. EXPERIMENTAL RESULT

The effectiveness of the proposed registration scheme is tested by performing different sets of experiments. The implemented algorithm is applied to the both reference and the target image. We apply the proposed 2-D LMS adaptive filtering technique to register real-world image pairs. A digital camera is used to take pictures from an outdoor scene.

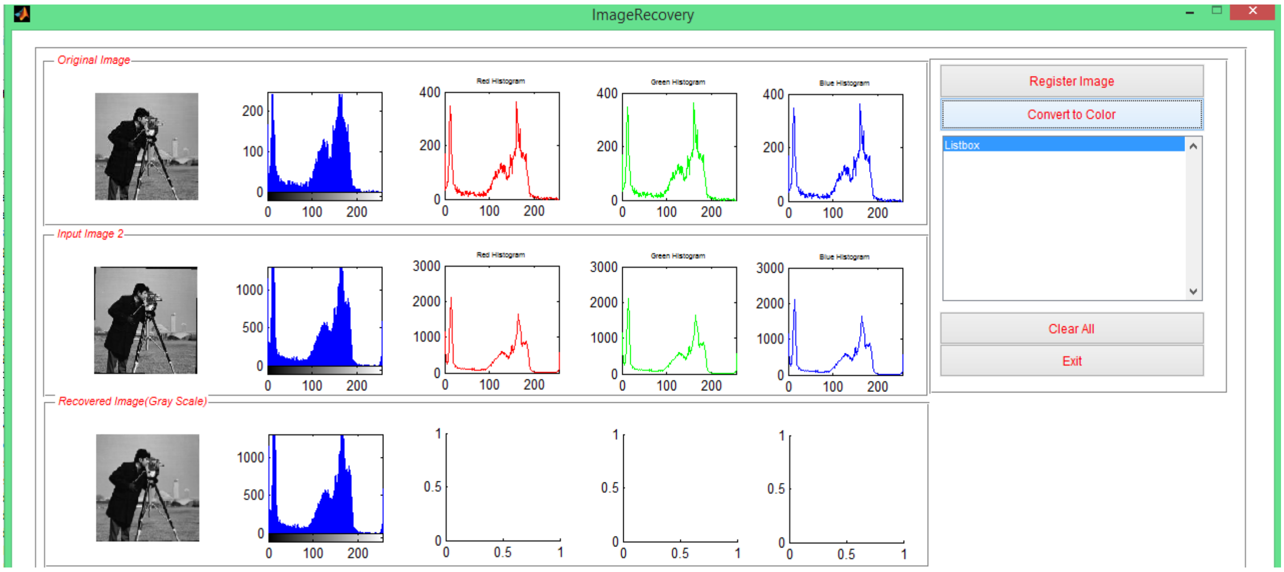

Fig 3: GUI

Example:

[a] Reference Image

[b] Target Image

[c]Registred Image

Fig 4: Implementation of proposed method.

In the above example, we have tested the proposed adaptive method on Cameramen.tif image. [a] is the reference image, [b] is the target image, which is to be registered and [c] is our output i.e. registered image. The original entropy and the mean intensity of the image is 17.10 and 0.30 respectively. After implementing the proposed adaptive filtering technique, entropy is 17.14 and intensity is 0.34 and calculated pSNR value of the registered image is 26.89 db with MSE= 53.46.

V. CONCLUSION

The proposed local image registration technique based on an adaptive filtering framework can handle smooth spatial variations in image registration and can be used to register images perturbed using Stirmark (for the purpose of watermark recovery), images with radial lens distortion, and multi-view images with small camera motion where parametric models are inadequate. In these applications, the technique offers significant improvements over global registration alone and over other common local registration techniques. The proposed method may be computationally simpler than other approaches for local image registration.

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References

1. Gulcin Caner, A. Murat Tekalp, "Local Image Registration by Adaptive Filtering", IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 15, NO. 10, OCTOBER 2006.
2. B. Zitova and J. Flusser, "Image registration methods: A survey," *Image Vis. Comput.*, vol. 21, no. 11, pp. 977–1000, Nov. 2003.
3. L. G. Brown, "A survey of image registration techniques," ACM Computing Surveys 24, pp. 325–376, Dec. 1992.
4. Manjusha P. Deshmukh & Udhav Bhosle, "A SURVEY OF IMAGE REGISTRATION", International Journal of Image Processing (IJIP), Volume (5) : Issue (3) , 2011.
5. Shiv BhagwanOjha and D. V Ravi Kumar, "Automatic Image Registration through Histogram-Based Image Segmantation", vol. 2, Issue 3, May-June 2012, pp.2430-2433.
6. Gaurav Sharma and Wendi Heinzelman, "Local Image Registration: An Adaptive Filtering Framework", Computational Imaging III , SPIE Vol. 5674.
7. Marius Staring, Stefan Klein and Josien P.W. Pluim, "Nonrigid Registration with Adaptive, Content-Based Filtering of the Deformation Field", Image Sciences Institute, University Medical Center Utrech, The Netherlands.
8. Vishnukumar S. and M. Wilscy, "Adaptive Local Image Registration for Colour Images"., Proceedings for the National Conference on Computational Science and Engineering- NCCSE-2009, pp.42-49, February 2009, ISBN: 978-81-907044-03.
9. C. Toklu, A. T. Erdem, M. I. Sezan, and A. M. Tekalp, "Tracking motion and intensity-variations using hierarchical 2D mesh modeling for synthetic object transfiguration," *CVGIP: Graph. Models Image Process.* vol. 58, no. 6, pp. 553 573, Nov. 1996.

AUTHOR(S) PROFILE

Bhavna B. Khajone, receives the Engineering degree in Information Technology from Prof. Ram Meghe Institute of Technology & Research, Badnera, Maharashtra, India in 2011 and Currently pursuing the M.E. in Computer Engineering From Sipna Engineering College, Amravati. Her interest lies in the Digital Image Processing and its application.

Prof. V. K. Shandilya, receives the engineering degree and M.E. in Computer Science & Engineering. She has the 10 year of teaching experience and her interest lies in Digital Image Processing and Operational Research.