# ACCURATE AND FAST DYNAMIC SUBPIXEL BASED TUMOR IMAGE RECOGNITION

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**ABSTRACT**

In recent years, the image processing technique has been applied in many significant fields, such as military, aerospace, and health industry. With the development of medical treatment, the computer-assisted diagnosis and treatment system play increasingly important roles. Methods: This paper presents a new fast and accurate image matching algorithm, which uses Breast Cancer B-scan images as test images. We first present a novel method to obtain the integer-pixel matching result, namely district-identification method. Then, we introduce gradient algorithm to match the sub-pixel position. Results: Experimental results show that the proposed method is about 2.3 times faster than traditional methods and can be suitable for images of arbitrary size. Moreover, it can improve performance in sub-pixel level and the recognition rate is above 96.30%. Conclusion: This paper proposes a novel image matching method to help medical experts to recognize the tumor location fast and accurately, find out the radiotherapy and chemotherapy target, and make full use of the medicines.

**Keywords: Treatment system, Tumor Image & B-scan Image**

## 1. INTRODUCTION

Cancer is the second dangerous disease in human around the world, especially in developing countries. At present, image processing techniques are used to detect and diagnose the Cancer Cell in computer aided automatic approach. Human Papilloma virus (HPV) is the primary reason for Cancer Celling human patients. The internal organs of the cervix of human body are affected by this virus, which leads to the formation of the cancer in cells. The cancer cells in the cervical image are categorized into benign cells and malignant cells. The benign cells are pre-cancerous cells and it is not spread over the inner areas of the cervix region. The malignant cells are the cancerous cells and it is spread over the inner region of the cervix. The cancer in cervix region is identified using Pap smear test or cervigram. In Pap smear test, the cells in the cervix region are tested and its nuclei regions are diagnosed. In cervigram method, the cervical images are used to detect the cancer region in cervix. In present scenario, the Cancer Cell can be identified at the final stage which causes sudden death. In many cases, the patients do not feel any irritations or pain in cervix region and it does not trigger any symptoms. The patient can be saved if the cancer is detected at an earlier stage. This is not possible for large population areas or developing countries. It also requires high number of trained physicians or radiologist to detect the Cancer Cell in human. Hence, there is a need for automatic detection and diagnosis system for Cancer Cell detection. This project proposes an automatic Cancer Cell detection method using image registration approach.

There are many differences between cancer cells and normal cells. Some of the differences are well known, whereas others have only been recently discovered and are less well understood. You may be interested in how cancer cells are different as you are coping with your own cancer or that of a loved one. For researchers, understanding how cancer cells function differently from normal cells lays the foundation for developing treatments designed to rid the body of cancer cells without damaging normal cells.

The first portion of this list discusses the basic differences between cancer cells and healthy cells. For those who are interested in some of the more difficult-to-understand differences, the second portion of this list is more technical.

## 1.1 IMAGE REGISTRATION AND ALGORITHM CLASSIFICATION

Image registration is a method to accomplish mapping between two different images of same scene taken at different times on regular time interval, from different viewpoints of same scene, and/or by different sensors to integrate the information. It's a method to superimpose the pixels from reference image to the target image by aligning the images into common coordinate system. The possible application areas of registration such as in remote sensing (image mosaicking, landscape planning, fusion of information, registration of aerial and satellite data into maps), in medical (monitoring of tumor evaluation, magnetic resonance image MRI, ultrasound, magnetic resonance spectroscopy, specimen classification, positron emission tomography PET, single photon emission computed tomography SPECT), and in computer vision (shape recovery, automatic change detection, motion tracking, automatic quality inspection, target template matching).

Aligning the images using different methods like Geometrical transformation, Point based method, surface based method and Intensity based method. It has been widely used in change detection, image fusion, clinical diagnosis and other related areas. Misalignment between the two images may be due to viewpoints, sensor position, viewing characteristics or from the object movement and deformation [2]. A great deal of work has been done on this important topic. More and more attention has been paid on main approaches and point out interesting parts of the registration methods.

Image registration is the process of transforming different sets of data into one coordinate system. Data may be multiple photographs, data from different sensors, times, depths, or viewpoints. [1] It is used in computer vision, medical imaging, [2] military automatic target recognition, and compiling and analyzing images and data from satellites. Registration is necessary in order to be able to compare or integrate the data obtained from these different measurements.

## 2. LITERATURE REVIEW

### IMAGE REGISTRATION METHODS: A SURVEY, IMAGE AND VISION COMPUTING

Zitova and Flusser [1], describes the various approaches of image registration is described like area based and feature based method and are retained and further classified into subcategories according to the basic ideas of matching methods. Also the four basic steps of image registration procedure: feature detection, feature matching, mapping function design, and image transform & resampling are mentioned. Major goals and outlook for future research as well as the advantages and drawbacks regardless of particular application area are discussed too.

### COMPARATIVE STUDY FOR IMAGE REGISTRATION TECHNIQUES OF REMOTE SENSING IMAGES, THE EGYPTIAN JOURNAL OF REMOTE SENSING AND SPACE SCIENCES

Ezzeldeen et al [2], design a comparative study between a Fast Fourier Transform (FFT)- based technique, a Contour-based technique, a Waveletbased technique, a Harris-Pulse Coupled Neural Network (PCNN)-based technique and HarrisMoment-based technique for remote sensing images to calculate the RMSE ranges, Timing results, and the average number of control points. It is concluded that that the more suitable technique is the FFT but having largest RMSE is above 2, where least running time technique is Contour (2.103sec for 256*256 and 2.214sec for 512*512 image size) and the technique having the largest Control points is Wavelet 30.

### MULTIMODALITY IMAGE REGISTRATION BY MAXIMIZATION OF MUTUAL INFORMATION, IEEE TRANSACTIONS ON MEDICAL IMAGING

Maes et al [3], proposed mutual information is a time consuming, but with the property of high precision image registration method. So to improve the computation efficiency images are registered with low resolution, and calculating entropy of reference and recent images, and the joint entropy of both. Now the pixels are mapped using the affine transform between the approximation coefficients. The coefficients parameterized with the six degrees of freedom of transformation. So an adaptive search for optimum transformation parameters was performed in order to maximize the mutual information. The approach with robustness evaluation and maximizing the mutual information are applied on rigid bodies of CT, MR, and PET images.

**MEDICAL IMAGE REGISTRATION FRAMEWORK USING MULTISCALE EDGE INFORMATION**

Li et al [4], proposed an efficient multiscale deformable registration framework, by combining the Edge preserving scale space (EPSS) with Free form deformation (FFD) for medical image registration. The proposed method shows the accuracy and robustness when compared to traditional methods for medical image processing by using the criteria of multiscale decomposition for medical images. The implemented framework also increases the efficiency of registration process, and improves the application for image guided radiation therapy with current medical system.

**HYBRID IMAGE REGISTRATION BASED ON CONFIGURAL MATCHING OF SCALE-INVARIANT SAILENT REGION FEATURES**

Huang et al [5], evaluates a hybrid method. In contrast with purely feature based or intensity based methods integrating the merits of both the approaches. By means of a small number of automatically extracted scale invariant salient region features, whose interior intensities can be matched using robust similarity measures. The goal is to identify as many good feature correspondences as possible, and fully utilize these correspondences to predict an appropriate transformation model for registration. The existing algorithms to feature matching consist of two steps: region component matching (RCPM) and region configural matching (RCFM), respectively. Procedure carried out by first finding the correspondence between individual region features now the joint correspondence detection between multiple pairs of salient region features using a generalized expectation-maximization framework and finally the joint correspondence is then used to recover the optimal transformation parameters.

## 3. EXISTING SYSTEMS

### 3.1 Image Registration in Frequency Domain

Correlation theorem states that, "the Fourier transform of the correlation of two images is the product of Fourier transform of one image and complex conjugate of Fourier transform of other". The Fourier transform of an image f (x, y) is a complex function, each function value has real part R (ωx, ωy) and an imaginary part I (ωx, ωy) at each frequency (ωx, ωy) of frequency spectrum. Shift theorem guarantees that phase of cross power spectrum is equivalent to the phase difference between the images.

If we represent the phase of cross power spectrum in its spatial form, i.e. by taking the inverse Fourier transform of the representation in the frequency domain, then we will have a function which is an impulse, which is approximately zero everywhere except at displacement which is needed to optimally register two images. Above method is used to register images having only translation.

### 3.2 Multimodal Image Registration Using Mutual Information

Registration of multispectral / multisensory images is a challenging area. In general, such images have different gray level characteristics and simple techniques such as those based on area correlation cannot be applied directly. This section is an attempt to solve this difficult problem by employing a basic concept from information theory. According to Manjusha Deshmukh and Udhav Bhosle [11], it is found that entropy of image does not change even if histogram has changed. Even after randomly shuffling pixels of image, entropy of image remains same. Also they concluded that natural images contain less uncertainty. In this type of images pixel intensity values depend on neighbouring pixels.

In other words, in natural image the value of pixel is likely to be very close to some of its neighbours. Hence this dependency reduces the total entropy [10].

## 4. PROPOSEDSYSTEM

### 4.1 Registration Process

Image registration is a process of mapping one image onto another image or similar object by using a perfect transformation. Registration aims to fuse the data from two or more images. When two images are taken one of them is referred as a reference image called original image which is kept untouched and other is called as a sensed image or template image and is employed to register the reference image.

Feature detection in this step the extraction of salient features/structures and distinctive objects from both reference and sensed images (like significant regions, edges, corners, points, or lines etc) are carried out. These features are represented by control points (CPs) which are centre of gravity, line endings, distinctive points, object contours, coastal lines, roads, line intersections, and road crossings which are invariant with respect to rotation, scaling, translation, and skewing.

### 4.2 Feature matching

In this section the major focus is on the feature detected in reference and sensed images. This approach is mainly divided onto two methods area based and feature based. Area based approach deals with the matching approach as on the predefined size or even entire image rather than on the salient features. While in case of the feature based approach the control points are estimated for a perfect match between a reference and sensed image. The whole focus is on the spatial relations or various descriptors of features.

### 4.3 Mapping function

After the feature detection and feature matching approach the corresponding mapping function is designed. The reference and sensed images are matched together using the mapping function design with the corresponding control points. The control points mapping must be as possible as much to make a significant influence in the resulting registration.

### 4.4 Transformation & Resampling

The sensed image is transformed and reconstructed with the mapping function the images are registered. The transformation can be realized in a forward or backward manner. Forward manner in which using mapping function the pixels from the sensed image is directly transformed. While in case of backward approach the pixels from the target image is determined and the inverse mapping function is established.

## 5. DIGITAL IMAGE PROCESSING AND MATLAB

### 5.1 DIGITAL IMAGE PROCESSING

Interest in digital image processing methods stems from two principal application areas:

Improvement of pictorial information for human interpretation

Processing of scene data for autonomous machine perception

In this second application area, interest focuses on procedures for extracting image information in a form suitable for computer processing.

Examples includes automatic character recognition, industrial machine vision for product assembly and inspection, military recognizance, automatic processing of fingerprints etc.

### 5.2 ELEMENTS OF DIGITAL IMAGE PROCESSING SYSTEMS

A digital image processing system contains the following blocks as shown in the figure

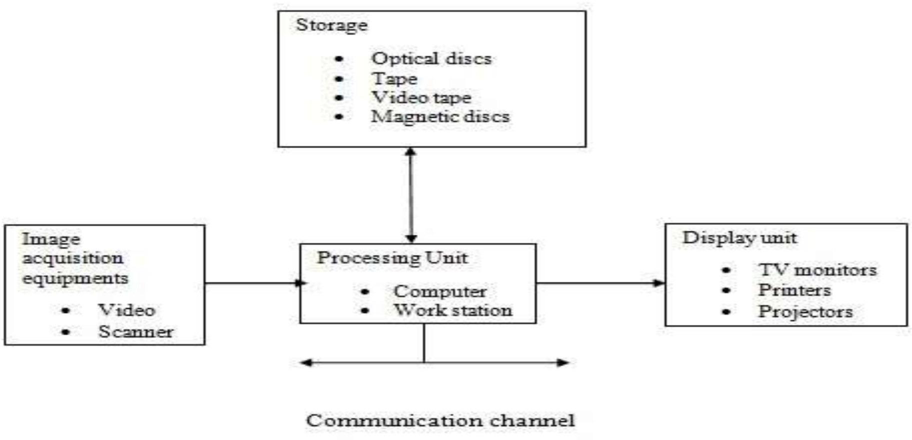



**Figure 1. Elements of digital image processing systems**

The basic operations performed in a digital image processing system include

Acquisition
Storage
Processing
Communication

Display

## 5.3 MATLAB

The name MATLAB stands for MATrix LABoratory. MATLAB was written originally to provide easy access to matrix software developed by the LINPACK (linear system package) and EISPACK (Eigen system package) projects. MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming environment. MATLAB has many advantages compared to conventional computer languages (e.g., C, FORTRAN) for solving technical problems. MATLAB is an interactive system whose basic data element is an array that does not require dimensioning. Specific applications are collected in packages referred to as toolbox. There are tool boxes for signal processing, symbolic computation, control theory, simulation, optimization, and several other fields of applied science and engineering.

## 5.4 MATLAB's POWER OF COMPUTAIONAL MATHMATICS

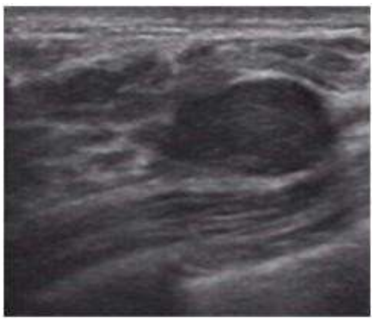
MATLAB is used in every facet of computational mathematics. Following are some commonly used mathematical calculations where it is used most commonly:

Dealing with Matrices and Arrays
2-D and 3-D Plotting and graphics
Linear Algebra
Algebraic Equations
Non-linear Functions
Statistics
Data Analysis
Calculus and Differential Equations Numerical Calculations
Integration
Transforms
Curve Fitting
Various other special functions

# 6 RESULTS

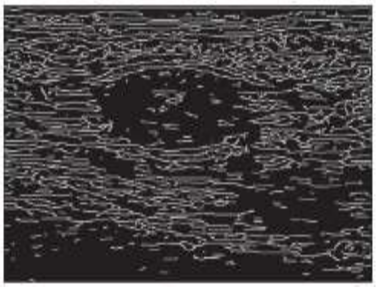
## 6.1 Performance Evaluation of the Subpixel Image Registration Technique

In addition to the experiments conducted in order to evaluate the performance of the proposed subpixel registration technique, the proposed technique was also compared to a recent frequency domain based method, [20], that outperforms existing techniques, [21], [28], [29]. In [20], the test images are obtained from high-resolution images (originally up-sampled by a factor 2) via down-sampling.

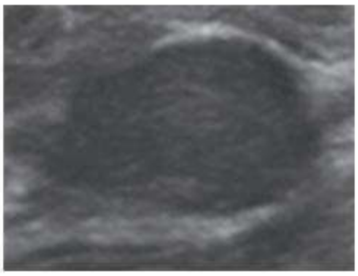


**Original tumor image**

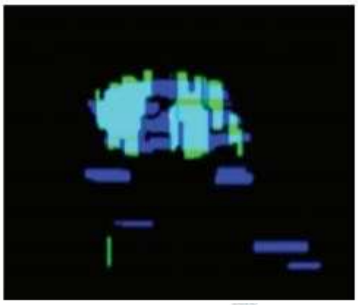
**Matching tumor image**



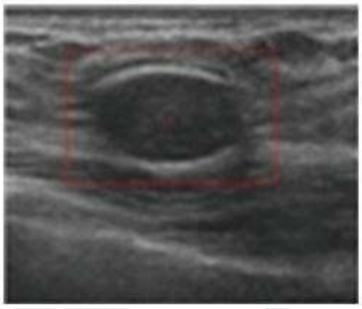
**Result image of edge detection**



**Re-intercept small original image**



**Preliminary matching result**



**The result image**

**Figure 2 Images used in the experiments**

**Table 1 Mean value of absolute Error**

| **Images** | **Mean Value of Absolute Error** | |
|---|---|---|
| Original tumor image | (0.0136, 0.0140) | (0.0105, 0.0111) |
| Matching tumor image | (0.0138, 0.0134) | (0.0106, 0.0108) |
| Result image of edge detection | (0.0171, 0.0154) | (0.0117, 0.0117) |
| Re-intercept small original image | (0.0123, 0.0097) | (0.0096, 0.0072) |
| Preliminary matching result | (0.0165, 0.0158) | (0.0125, 0.0118) |
| The result image | (0.0124, 0.0152) | (0.0094, 0.0118) |
| Original tumor image with Noise | (0.0247, 0.0281) | (0.0231, 0.0259) |
| Matching tumor image with Noise | (0.0361, 0.0332) | (0.0329, 0.0301) |
| Result image of edge detection with Noise | (0.0570, 0.0446) | (0.0543, 0.0446) |
| Re-intercept small original image with Noise | (0.0452, 0.0229) | (0.0442, 0.0208) |
| Preliminary matching result with Noise | (0.0298, 0.0212) | (0.0269, 0.0172) |
| The result image with Noise | (0.0222, 0.0226) | (0.0186, 0.0195) |
| Sampled Original tumor image | (0.0368, 0.0336) | (0.0383, 0.0269) |
| Sampled Matching tumor image | (0.0321, 0.0486) | (0.0275, 0.0422) |
| Sampled Result image of edge detection | (0.0266, 0.0229) | (0.0238, 0.0167) |
| Sampled Re-intercept small original image | (0.0419, 0.0358) | (0.0333, 0.0272) |
| Sampled Preliminary matching result | (0.0459, 0.0289) | (0.0372, 0.0234) |

| | | |
|---|---|---|
| Sampled The result image | (0.0333, 0.0443) | (0.0275, 0.0386) |
| Sampled Original tumor image with Noise | (0.0368, 0.0339) | (0.0395, 0.0276) |
| Sampled Matching tumor image with Noise | (0.0321, 0.0486) | (0.0285, 0.0438) |
| Sampled Result image of edge detection with Noise | (0.0287, 0.0225) | (0.0268, 0.0188) |
| Sampled Re-intercept small original image | (0.0419, 0.0362) | (0.0344, 0.0284) |
| Sampled Preliminary matching result with Noise | (0.0463, 0.0287) | (0.0384, 0.0238) |
| Sampled The result image with Noise | (0.0338, 0.0439) | (0.0283, 0.0388) |

Integer shifts in the high-resolution images correspond to subpixel (non-integer) shifts in the resulting images. In order to control the amount of aliasing, a low pass filter is used prior to down-sampling. Furthermore, the initial images are multiplied by a Tukey window in order the images to be circularly symmetric, thus avoiding all boundary effects. Similar approaches for producing images with subpixel translations were used in [16], [18], [19] and
[30].

Several pairs of original and translated images were generated by using either of the following two ways. Results are given for the images. First, pairs of images were generated by applying the Matlab code provided in [31].

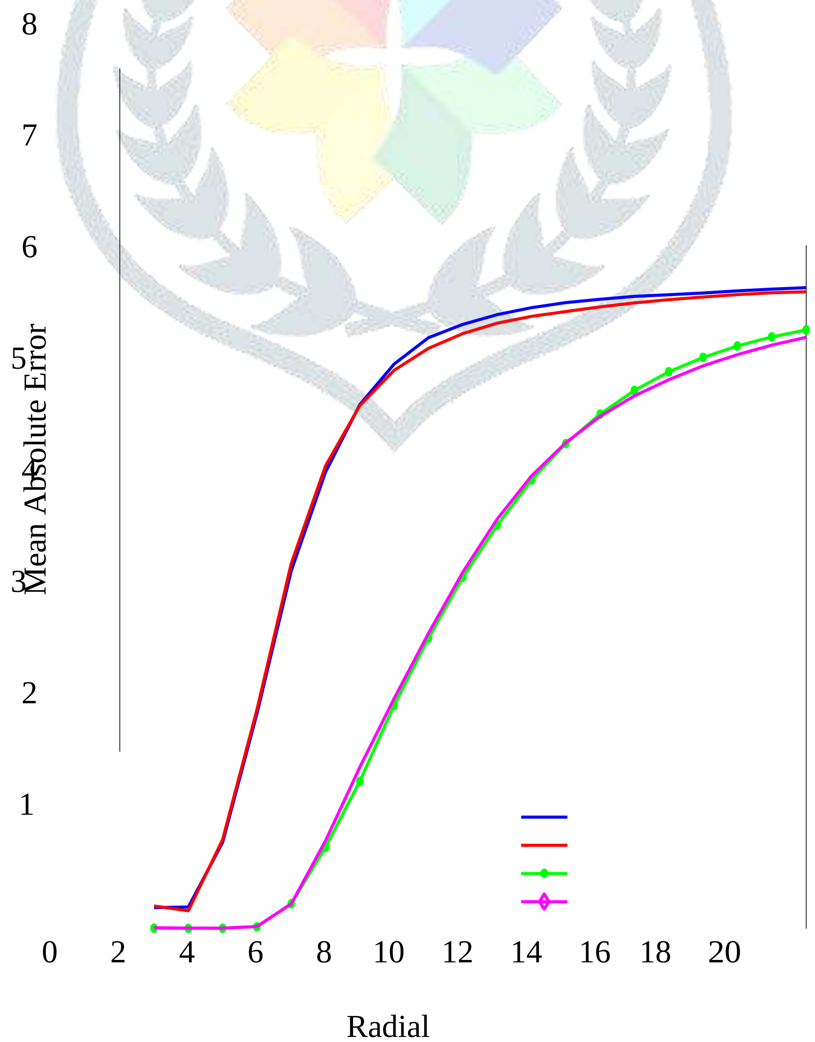



**Figure 3 Mean absolute error for the method**

Second, other pairs of images were generated using the Matlab Camera Tool. More specifically, in this case, we created a plane in 3D space and we set the angle from which the camera views the current 3D plot, so as to have the same depth for all the plane points. In particular, we set the azimuth equal to 0 and the vertical elevation equal to 90 degrees. In this way we simulated a planar motion model, moving the camera to both directions and capturing images from different viewpoints. Since in this paper we investigated the pure translation case, we made use of the *camdolly* Matlab function.

## 7. CONCLUSION

A new technique for subpixel image registration is proposed in this paper. It is based on the maximization of the correlation coefficient. An easily computed closed form solution is derived, which does not require the reconstruction of the images intensities, as the interpolation-based methods do. It provides registration of high accuracy and is robust to photometric distortions. Moreover, an efficient spatial domain algorithm is proposed that with high probability reduces significantly the computational cost of the image registration problem. This algorithm is robust to noise and properly combined with the subpixel accuracy technique results in a fast spatial domain technique for subpixel image registration.

The fast subpixel registration of cancer region in cervical images plays an important role in cervical cancer diagnosis. In this paper, image registration based cervical cancer detection and segmentation methodology is proposed using ANFIS classifier. The proposed system achieves 97.14% and 100% of classification accuracy for non-cancerous and cancerous cervical images, respectively. This proposed methodology for cervical images classification achieves 98.57% of overall classification accuracy. The performance analysis of proposed cervical cancer detection and segmentation system achieves 97.42% sensitivity,
99.36% specificity and 99.36% segmentation accuracy. Simulations on different aspects prove that the proposed methodology stated in this paper achieves high performance for clinical practice. In future, the temporal and spatial relationship between each pixel is considered for improving the performance of the cervical cancer detection and diagnosis process.

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