International Journal of Advanced Multidisciplinary Research (IJAMR)
ISSN: 2393-8870
www.ijarm.com
Coden:IJAMHQ(USA)

Research Article

SOI: http://s-o-i.org/1.15/ijarm-2-12-4

Analysis of donoho's approach for image restoration for improving the performance

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Keywords

Specific applications, Co-ordinate system

Abstract

The implementation of the regularized inverse filter involves the estimation of the power spectrum of the original image in the spatial domain. Since wavelet transforms have good decor relation property, the wavelet coefficients of the image can be better modeled in a stochastic model, and the power spectrum can be better estimated. Registration algorithms compute transformations to set correspondence between the two images the purpose of this paper is to provide a comprehensive review of the existing literature available on Image registration methods. We believe that it will be a useful document for researchers longing to implement alternative Image registration methods for specific applications.

Introduction

Although the Wiener filtering is the optimal tradeoff of inverse filtering and noise smoothing, in the case when the blurring filter is singular, the Wiener filtering actually amplify the noise. This suggests that a denoising step is needed to remove the amplified noise. Wavelet-based denoising scheme, a successful approach introduced recently by Donoho, provides a natural technique for this purpose. Therefore, the image restoration contains two separate steps: Fourier-domain inverse filtering and wavelet-domain image denoising. Image registration finds its applications in various fields like remote sensing (multispectral classification), environmental monitoring, change detection, image mosaicing, weather forecasting, creating super-resolution images, integrating information into geographic information systems (GIS)), in medicine (combining data from different modalities e.g. computer tomography (CT) and magnetic resonance imaging (MRI), to obtain more complete information about the patient, monitoring tumor growth (Figure 1)

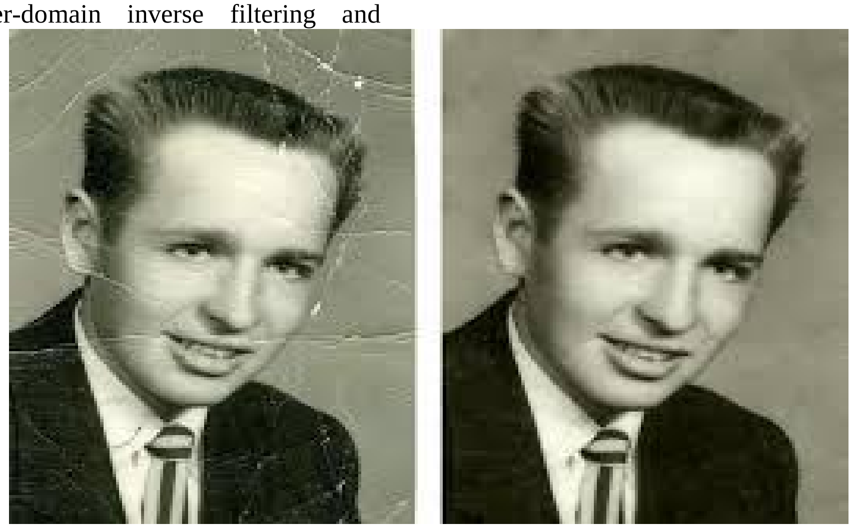

Figure 1. Application of Image registration in MR mammography.

Image restoration is different from image enhancement in that the latter is designed to emphasize features of the image that make the image more pleasing to the observer, but not necessarily to produce realistic data from a scientific point of view. Image enhancement techniques (like contrast stretching or de-blurring by a nearest neighbor procedure) provided by imaging packages use no a priori model of the process that created the image.

With image enhancement noise can effectively be removed by sacrificing some resolution, but this is not acceptable in many applications. In a fluorescence microscope, resolution in the z-direction is bad as it is. More advanced image processing techniques must be applied to recover the object.

Feature detection: Salient and distinctive objects (closed-boundary regions, edges, contours, line intersections, corners, etc) in both reference and sensed images are detected.

- Feature matching: The correspondence between the features in the reference and Sensed image established.
- Transformations using Fourier analysis
- Cross correlation approach using Fourier analysis
- Sum of squares search technique
- Eigen Value Decomposition
- Moment matching techniques
- Warping Techniques
- Procedural approach
- Anatomic Atlas
- Internal landmarks
- External Landmarks

Donoho's approach for image restoration improves the performance; however, in the case when the blurring function is not invertible, the algorithm is not applicable. Furthermore, since the two steps are separate, there is no control over the overall performance of the restoration. Recently, R. Neelamani et al. proposed a wavelet-based deconvolution technique for ill-conditioned systems. The idea is simple: employ both Fourier-domain Wiener-like and wavelet-domain regularization.

Enhancement

The aim of image enhancement is to improve the interpretability or perception of information in images for human viewers, or to provide `better' input for other automated image processing techniques.

Image enhancement techniques can be divided into two broad categories:

1.Spatial domain methods, which operate directly on pixels, and
2. Frequency domain methods, which operate on the Fourier transform of an image.

Unfortunately, there is no general theory for determining what 'good' image enhancement is when it comes to human perception. If it looks good, it is good! However, when image enhancement techniques are used as pre-processing tools for other image processing techniques, then quantitative measures can determine which techniques are most appropriate.

Conclusion

However, one usually expects the value of a pixel to be more closely related to the values of pixels close to it than to those further away. This is because most points in an image are spatially coherent with their neighbors; indeed it is generally only at edge or feature points where this hypothesis is not valid. Accordingly it is usual to weight the pixels near the centre of the mask more strongly than those at the edge. Some common weighting functions include the rectangular weighting function above (which just takes the average over the window), a triangular weighting function, or a Gaussian. In practice one doesn't notice much difference between different weighting functions, although Gaussian smoothing is the most commonly used. Gaussian smoothing has the attribute that the frequency components of the image are modified in a smooth manner.

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