

بسم الله الرحمن الرحيم



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Speckle Noise Reduction on Medical Ultrasound Imaging

تقليل ضوضاء الرقطة في صور الموجات فوق الصوتية

A project submitted for fulfillment of requirement for the B.Sc. (honor)
degree in biomedical engineering.

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Abbreviations

US	UltraSound
TGC	Time Gain Compensation
US B-mode	Ultrasound Brightness mode
US A-mode	Ultrasound Amplitude mode
US M-mode	Ultrasound Motion mode
ICA	Internal Carotid Artery
SAR	Synthetic Aperture Radar
FFS	Fully Formed Speckle pattern
NRLR	Non Randomly distributed with Long-Range order
NRSR	Non Randomly distributed with Short-Range order
PDF	Probability Density Function
gf4d	Geometric Filter
ca	Linear scaling gray level filter
lecasort	Linear scaling and sorting filter
PDE	Partial Differential Equation
ad	Anisotropic Diffusion Filtering
srad	Reducing Anisotropic Diffusion
DSF	Descete Fourier Transformer
TV	Total Variation Filters
ROF	Rudin-Osher-Fatemi
RMSE	Root Mean Square Error
SNR	Signal to Noise Ratio
PSNR	Peak Signal to Noise Ratio
SSIM	Structural Similarity Index
DWT	Discreet Wavelet Transform
IDWT	Inverse Discreet Wavelet Transform
Hrm	Haar median technique

u

Abstract

Today, ultrasound (US) is one of the most widely used imaging technologies in medicine. It is portable, free of radiation risk, and relatively inexpensive when compared with other imaging modalities.

The ultrasound (US) B-Scan images are obtained with a simple linear or sector scan US probe, which show a granular appearance called speckle. This noise lead to degrades the target detectability and recognition and reduces the contrast , resolutions which affect the human ability to identify normal and pathological tissue.

The objective of this project is to give an overview about types of speckle reduction techniques in ultrasound imaging . And To carry out a comparative evaluation of despeckle filtering based on image quality evaluation metrics.

Anew speckle suppression methods and coherence enhancement of medical ultrasound images were proposed , combines median filter and wavelet shrinkage. It has been found that quality evaluation metrics the proposed method performs better than all other methods while still retaining the structural details and experimental results show that this method retains the edges and textures very well while removing noise.

المستخلص

اليوم، الموجات فوق الصوتية (US) هي واحدة من تقنيات التصوير الأكثر استخداما على نطاق واسع في الطب. وهي اجهزة محمولة، وخالية من الخطر الاشعاعي، وغير مكلفة نسبيا مقارنة مع طرائق التصوير الاخرى. الموجات فوق الصوتية يتم الحصول على الصورة السطوح B-Scan images بالماسح الضوئي مع خطي بسيط، والتي تظهر مظهر حبيبات تسمى الرقطة. وهذه الضوضاء تقود الى تقليل التباين والدقة التي تؤثر على قدره الانسان على تحديد الانسجة الطبيعية من المريض. ان الهدف من هذا المشروع هو اعطاء لمحمة عامه عن انواع التقنيات التي تساعد على ازالة الرقطة في صور الموجات فوق الصوتية. ولإجراء تقييم التقنيات على اساس مقاييس تقييم جوده الصورة. واقتراح اساليب جديدة لازالة الرقطة وتعزيز تماسك صور الموجات فوق الصوتية الطبية، وذلك بالجمع بين المرشح المتوسط وموجات انكماش. وقد وجد ان مقاييس تقييم الجودة تنفذ الطريقة المقترحة افضل من كل الوسائل الاخرى في حين لا يزال الابقاء على التفاصيل الهيكلية والنتائج التجريبية تبين ان هذا الاسلوب يحتفظ بالحواف و القوام جيدا اثناء ازالة الضوضاء.

Chapter One

Introduction

1.1 General review

The medical imaging devices namely X-ray, Computed Tomography/Magnetic Resonance Imaging and ultrasound are producing abundant images which are used by medical practitioners in the process of diagnosis.

The main problem faced by them is the noise introduced due to the consequence of the coherent nature of the wave transmitted. Noise is defined as unwanted signals. There are different filters to remove single type of noise such as salt and pepper, speckle noise, Gaussian noise etc. These noises corrupt the image and often lead to incorrect diagnosis. For example, the x-ray images are often corrupted by Poisson noise, while the ultrasound images are affected by Speckle noise. Speckle is a complex phenomenon, which degrades image quality with a backscattered

wave appearance which originates from many microscopic diffused reflections that passing through internal organs and makes it more difficult for the observer to discriminate fine detail of the images in diagnostic examinations. Thus, denoising or reducing these speckle noise from a noisy image has become the predominant step in medical image processing.[6]

1.2 Problem of the statement

The usefulness of ultrasound imaging is degraded by the presence of signal dependant noise known as speckle. This noise is difficult and different from other types of noise because related to the signal and should be processed and removing without affecting important image features.

1.3 Objective

Give an overview about speckle noise, how to generate, has properties, and what the effectiveness of it on the ultrasound image.

1.4 Specific objectives

1. Learning about types of speckle reduction techniques in ultrasound imaging.
2. To carry out a comparative evaluation of despeckle filtering based on image quality evaluation metrics.
3. Propose new method as a despeckle filter based on hybrid techniques.

1.5 Methodology

Images from the IBE Tech (Giza, Egypt) database of ultrasound images including liver, unborn, and GYN-abnormal-hematometra image. In the quantitative study, add speckle noise with different variance on ultrasound images and using a most importantly techniques to removing that noise.

The new technique of despeckling which based on method that applied the median filter in wavelet transformation of ultrasound image, was applied on noisy images, and then the quality evaluation metrics was found from all methods to compare the performance of those filters.

1.6 Thesis layout

The layout of this project consist of six chapters there are :chapter one include introduction and general review , while chapter two involve theoretical background ultrasound system, speckle noise and despeckle filter in chapter three, in chapter four the materials and method description , however in chapter five the results and discussion were viewed, finally chapter six is conclusion and future work.