

Dedication

To whom care about me till i was helpful and useful

My parents

To whom are kindly help me to achieving my dreams

My sisters and brothers

To whom assists me with efforts and prayers

My friends

To all who like me and whom i like, i dedicate this project.

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Table of Contents

Dedication	I
ACKNOWLEDMENT.....	II
Table of Contents.....	III
LIST of FIGURES.....	VI
LIST of TABLES	IX
ABBREVIATIONS	X
Abstract.....	XII
المستخلص	XIV
CHAPTOR ONE: INTRODUCTION.....	1
1.1 General View.....	1
1.2 The Problem Statement	4
1.3 Thesis Objectives	4
1.4 Methodology	5
1.5 Thesis Layout.....	5
CHAPTOR TWO: THEORATICAL BACKGROUND.....	7
2.1 Ultrasound waves characteristic.....	7
2.1.1 Waves Motion	7
2.1.2 Ultrasound Wave length and Frequency	8
2.2 Ultrasound and Material Properties	10
2.3 Ultrasound – Tissue Interaction	11
2.3.1 Reflection	12
2.3.2 Scattering.....	14
2.3.3 Refraction	16
2.3.4 Absorption:.....	16
2.3.5 Attenuation.....	17

2.4 Ultrasound Equipments	18
2.4.1 Major Controls.....	20
2.4.2 Ultrasound Block Diagram.....	21
2.4.3 Ultrasound major modes	23
2.4.4 Clinical Applications	25
2.4.5 Ultrasound Beam Shape	26
2.4.6 US Transducers	31
2.4.7 Some US image artifacts	36
CHAPTER THREE:LITERATURE REVIEW.....	40
3.1 Analog Beam-forming.....	40
3.2 Digital Beam-forming.....	49
3.2.1 Digital Beam-former basics	50
CHAPTER FOUR:METHODOLOGY.....	60
4.1 Block Diagram.....	61
4.2 Delay Equation	61
4.3 physical Array Elements.....	63
4.3.1 Linear Array Reconstruction.....	63
4.3.2 Linear Phase Array Reconstruction	66
4.4 Apodization	69
4.5 Envelope Detection.....	71
4.5.1 FIR Hilbert Transform Filter Design.....	71
4.6 Compressed the Dynamic Range.....	74
4.7 Graphical User Interface.....	76
CHAPTER FIVE: RESULTS AND DISCUSSION	81
5.1 Ultrasound Data	81
5.2 Main Window:	81
5.3 RF Information Window:	82
5.4 Physical Linear array reconstruction	83
5.4.1 Primary Reconstruction Windows.....	83

5.4.2 Secondary Reconstruction Windows	87
5.5 Physical Linear phase array reconstruction.....	95
5.5.1 Primary Reconstruction Window.....	95
5.5.2 Secondary Reconstruction Windows	96
CHAPTER SIX: CONCLUSION AND FUTURE WORKS.....	99
6.1 Conclusion	99
6.2 Future Works	99
REFERENCES.....	101

Appendix

LIST of FIGURES

Figure 1.1: Obstetrical ultrasound images demonstrating both 2D (right) and 3D (left) reconstructions.....	2
Figure 2.1: The disturbance travel across the ponds.....	8
Figure 2.2: In a longitudinal wave particle motion is aligned with the direction of travel, result in bands of high and low pressure.....	8
Figure 2.3: Attenuation of US waves and its relation to wave frequency	9
Figure 2.4: A comparison of the resolution and penetration of different US transducer frequencies.....	10
Figure 2.5: Schematic representation of US pulse generation	10
Figure 2.6: Sound wave travelling through two medium	12
Figure 2.7: Specular reflection	14
Figure 2.8: Small targets scatter the wave over a large angle	15
Figure 2.9: Rough surface reflects the wave over a range of angles	15
Figure 2.10: US attenuation with distance.....	17
Figure 2.11: Medical imaging pipeline example.....	18
Figure 2.12: External parts of an ultrasound imaging system (courtesy of Philips Medical Systems).....	20
Figure 2.13: Keyboard of an ultrasound imaging.....	21
Figure 2.14: Block diagram of digital ultrasound imaging system.....	23
Figure 2.15: US beam shape from a plane disc source.....	26
Figure 2.16: US beam with a concave crystal	27
Figure 2.17: US beam focused with acoustic lens	28
Figure 2.18: receive focus beam-forming a) geometric transducer b) array without delays c) Array with delays	29
Figure 2.19: Approximation of path difference as related to element space.....	30
Figure 2.20: Grating lobes	31
Figure 2.21: Ultrasound transducer components.....	33

Figure 2.22: Common ultrasound transducer types	33
Figure 2.23: Linear and curvilinear scan format	34
Figure 2.24: Electronic scanning with linear switched array	35
Figure 2.25: Linear and curvilinear scan format	35
Figure 2.26: Electronic scanning with a linear phased array.....	36
Figure 2.27: Clean shadow	37
Figure 2.28: Dirty shadow	37
Figure 2.29: An edge shadow artifact	38
Figure 2.30: mirror artifact	39
Figure 3.1: A delay line beam-former uses selectable fixed taps to vary the delay on each signal.....	47
Figure 3.2: A coarse/fine delay beam-former uses fixed taps for coarse adjustment along with a phase shift for fine adjustment.....	49
Figure 3.3: Basic geometry for beam-former calculations	51
Figure 4.1: Block diagram of proposed method for transform RF data to B-mode image...	61
Figure 4.2: Geometry of a focused transducer array.....	62
Figure 4.3: Creating transmission focus for a linear array transducer.....	64
Figure 4.4: Creating receive focus for a linear array transducer.....	65
Figure 4.5: Physical linear array elements.....	65
Figure 4.6: Creating transmission focus for a phased array transducer.....	66
Figure 4.7: Creating receive focus for a phased array transducer.....	67
Figure 4.8: Geometry for raster point technique	68
Figure 4.9: Apodization technique in transmit and receive beam.....	69
Figure 4.10: Shape of beam with and without apodization	70
Figure 4.11: 64-length black-man window in time and frequency domain.....	70
Figure 4.12: Hilbert transform relations between $x_r(t)$ and $x_i(t)$ to generate $x_c(t)$	73
Figure 4.13: Log transformation functions used for image enhancement.....	75
Figure 4.14: GUI template in the layout.....	78
Figure 5.1: The main window of the tool	82
Figure 5.2: The RF signal in time and frequency domain	82

Figure 5.3: The delay used with AP=16	83
Figure 5.4: Image reconstructed with physical linear array using AP=4	84
Figure 5.5: Image reconstructed with physical linear array using AP=8	84
Figure 5.6: Image reconstructed with physical linear array using AP=16	85
Figure 5.7: Image reconstructed with physical linear array using AP=32	85
Figure 5.8: Image reconstructed with physical linear array using AP=64	86
Figure 5.9: SNR for images reconstructed with AP=4, 8, 16, 32 and 64	86
Figure 5.10: Ultrasound beam with and without apodization	87
Figure 5.11: Six pins phantom image reconstructed using AP=8 before and after apodization.....	88
Figure 5.12: Rectangular window of length 16 in time and frequency domain.....	89
Figure 5.13: Hamming window of length 16 in time and frequency domain	89
Figure 5.14: Kaiser ($\beta=4$) window of length 16 in time and frequency domain.....	90
Figure 5.15: Blackman window of length 16 in time and frequency domain	90
Figure 5.16: Image reconstructed using AP=8 before and after envelope detection	91
Figure 5.17: RF signal before and after envelope detection in the frequency domain	91
Figure 5.18: The envelope of RF signal in time domain	92
Figure 5.19: The analytical envelope (real and quadrature signal).....	93
Figure 5.20: Log transformation function	93
Figure 5.21: Image reconstructed using AP=8 after log transformation	94
Figure 5.22: RF signal in time domain before and after log transformation	94
Figure 5.23: Images reconstructed with physical phase linear array using F=4, 16	96
Figure 5.24: Images reconstructed using F=4, 16 after apodization.....	96
Figure 5.25: Images reconstructed using F=4, 16 after envelope detection.....	97

Figure 5.26: Images reconstructed using F=4, 16 after log transform..... 97

LIST of TABLES

Table 2.1: Values of acoustic impedance	11
Table 2.2: Amplitude-reflection coefficient of interfaces	13
Table 2.3: The different components of an US transducer.....	32

ABBREVIATIONS

ADC	Analog to Digital Converter
AP	Aperture
A-mode	Amplitude mode
B-mode	Brightness Modulation mode
CRT	Cathode Ray Tube
CT	Computer tomography
Db	Decibel
DAS	Delay and Sum method
FIR	Finite Impulse Response
IIR	Infinite Impulse Response
KHz	Kilo Hertz
LC	Lumped Inductor Capacitor
LTI	Linear Time Invariant
MATLAB	Matrix Laboratory
MHz	Mega Hertz

M-mode	Motion mode
MRI	Magnetic Resonance
PC	Personal Computer
PL	Pulse Length
PRF	Pulse Repetition Frequency
RF	Radio Frequency
SA	Synthetic Aperture
SAFT	Synthetic Aperture Focusing Technique
SDF	Sampled Delay Focusing
SNR	Signal to Noise Ratio
SRA	Synthetic Receive Aperture
STA	Synthetic Transmit Aperture
TDL	Tapped Delay Line
TGC	Time Gain Compensation
TV	Television
US	Ultrasound

Abstract

Real-time ultrasonic imaging systems have been available for more than sixty years and are becoming an important tool in the practice of modern medicine. During this time much has occurred to the basic architecture and functions of these clinical systems and their beam-formers, which are the most important components of them. The thesis was focused on developing a new tool in MATLAB which should assist students in understanding the necessary processing steps to convert digital ultrasound radio frequency data to brightness modulation images. The tool will provide the user with a framework for the processing pipeline, it also provides the user with the ability to test signal processing methodologies for digital beam-forming which include: receive focusing, the apodization technique and its effect to reduce the side-lobes, the analytical envelope detection using digital finite impulse response (FIR) Hilbert transformer and how to compress the dynamic range to achieve the desired dynamic range for display (8 bits). Here the image was reconstructed using physical array elements for linear and phase array probe.

A compact educational software digital ultrasound imaging system that has almost all its processing steps done on the personal computer (PC) side using MATLAB program will be presented by this study. Correct data obtained from the Biomedical Ultrasound Laboratory, University of Michigan will be used in this project; the phantom data set that will be used to generate the results here is under "Acuson17".

Two types of images will be provided by this thesis; the first image will be reconstructed using linear array reconstruction technique, the second image will be reconstructed using linear phase array reconstruction technique.

المستخلص

لقد كان جهاز التصوير بالموجات فوق الصوتية متوفراً منذ أكثر من ستون عام وأصبح من أهم الأجهزة المستخدمة في المجالات الطبية. خلال هذه الفترة حدث الكثير من التغيرات في البنية الأساسية والوظيفية للجهاز ، والجزء الأوفر حظاً في التغيير هو ال beam-forming الذي يعتبر الجزء الأكثر أهمية في جهاز التصوير بالموجات فوق الصوتية.

هذه الدراسة ترتكز على تطوير أداة جديدة بإستخدام برنامج الماتلاب لمساعدة الطلاب في التعرف وفهم الخطوات الأساسية التي تستخدم في تحويل الموجات فوق الصوتية إلى صورة B-mode. هذه الأداة سوف تتم المستخدمة بإمكانية اختبار كل خطوات المعالجة الخاصة بال beam-forming والتي تشمل:

تركيب الموجات المرتدة (receive focusing), تقنية ال apodization وأثرها في تقليل ال side lobes، حساب ال envelope باستخدام ال FIR Hilbert Transform وأخيراً كيفية تقليل ال dynamic range بإستخدام ال Log Transformation.

هذا البحث يقدم أداة تعليمية تقوم بتنفيذ معظم خطوات المعالجة التي تحتاجها للحصول على صورة موجات صوتية في جهاز الكمبيوتر بإستخدام برنامج الماتلاب. في هذا البحث سوف يتم تقديم صورتين الأولى تم الحصول عليها عن طريق ال linear array reconstruction technique ، والثانية تم الحصول عليها بال linear phase array reconstruction technique. تم تطبيق الخطوات السابقة على بيانات مأخوذة من المعمل الطبي للموجات فوق الصوتية Biomedical Ultrasound Laboratory . "Acuson17" ، جامعة ميشيغان، وهي تحت مسمى