UNIVERSITI PUTRA MALAYSIA

PRE-PROCESSING EDGE DETECTION IMAGE ENHANCEMENT AND SPATIAL OBJECT VELOCITY ESTIMATION FOR ECHOCARDIOGRAPH DIAGNOSTIC TEST

ZINAH RAJAB HUSSEIN

FSKTM 2010 6
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AND SPATIAL OBJECT VELOCITY ESTIMATION FOR
ECHOCARDIOGRAPH DIAGNOSTIC TEST

By

ZINAH RAJAB HUSSEIN

Thesis Submitted to the School of Graduate Studies, University Putra
Malaysia, in Fulfilments of the Requirements for the Degree of Master

October 2010
Dedicated
To
My Family
Abstract of the thesis presented to the Senate of the University Putra Malaysia in fulfillment of the requirements for the degree of Master of Science

PRE-PROCESSING EDGE DETECTION IMAGE ENHANCEMENT AND SPATIAL OBJECT VELOCITY ESTIMATION FOR ECHOCARDIOGRAPH DIAGNOSTIC TEST

By
ZINAH RAJAB HUSSEIN
October 2010

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Faculty: Computer Science and Information Technology

Echocardiograph imaging is a primary modality in the diagnosis of heart disease. Compared to other imaging techniques, such as X-Ray, MRI, and PET, echocardiograph imaging owes its great popularity to the fact that it is a safe and non-invasive procedure for visualizing the heart and vasculature. The echocardiograph image however is corrupted by speckle noise and low contrast, which make feature detection and tracking difficult.

This thesis focuses on two important issues for the clinical applications of medical echocardiograph images: speckle suppression and motion estimation. The thesis first presents visualization enhancement method to clarify the heart structure and the movement of the valves. This method is designed to extract the contours of heart boundaries from a sequence of echocardiograph images, where it started with pre-processing to reduce noise and get better image quality. These pre-processing operations involved the use of median filtering, morphological opening and contrast adjustment. Thereafter, Sobel edge
detection was applied and the resulted image combined with image after opening stage. This method validated visually by medical students using real echocardiograph images. Performance improvement of this method evaluated as it provides very significant speckle suppression and edge enhancement for the purposes of visualization and automatic structure detection.

Second issue in this thesis is improving the detection of wall motion abnormality by quantitative analysis. The analysis of the left ventricular wall motion in routine is mostly based on visual interpretation of echocardiograph image. The interpretation of these images is widely dependent on operator training and is subject to large variability. To reduce this inter and intra-observers variability, the utilization of optical flow technique presented to estimate the left ventricular wall motion and create a cardiac motion profile based on the anatomical structure of the left ventricular wall in cross sectional view. This profile presenting the anatomical structure provides an additional means for functional imaging and eliminates the need to build a large dataset containing specific parameters of the patient to obtain an accurate diagnosis. In addition, the segmentation into three parts corresponding to the three major coronary arteries was meaningful for cardiac surgery. As a result, this method achieves an estimation of regional myocardial function with percentage of validations 71.4%, which is encouraging. In conclusion, estimation of regional myocardial deformation from intracardiac echocardiography by depending on anatomical knowledge is feasible. This work could be an important aid to improve and support diagnostic accuracy and the prognostic method for left ventricular diseases.
Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
Sebagai memenuhi keperluan untuk ijazah Master

PRA-PEMPROSESAN PENGESANAN TEBING PENINGKATAN IMEJ
DAN KECEPATAN OBJEK SPASIAL EKOKARDIOGRAF ESTIMASI
UNTUK TEST DIAGNOSTIK

Oleh
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Oktober 2010

Pengerusi: Professor Madya Rahmita Wirza O.K. Rahmat, PhD
Fakulti: Fakulti Sains Komputer dan Teknologi Maklumat

Pengimejan ekokardiograf merupakan modalitas utama dalam diagnosis penyakit jantung. Dibandingkan dengan teknik-teknik pengimejan yang lain, seperti sinar-X, MRI dan PET, populariti pengimejan ekokardiograf disebabkan fakta bahawa ia selamat dan merupakan prosedur non-invasif bagi visualisasi jantung dan pembuluh darah. Walau bagaimana pun, imej ekokardiograf dirusakkan dengan hingar spekel dan kontras yang rendah, yang mana akan menyukarkan pengesanan dan pelacakan.

Tesis ini focus kepada dua isu yang penting bagi aplikasi klinikal imej perubatan ekokardiograf: spekel penindasan dan estimasi gerakan. Pertama tesis akan persembahkan kaedah peningkatan visualisasi bagi memperjelas struktur jantung dan pergerakan injap. Kaedah ini direkabentuk bagi mengekstrak kontur-kontur batas jantung dari jujukan imej-imej ekokardiograf, yang mana ia bermula dengan pra-pemprosesan bagi pengurangan hingar dan

Isu kedua dalam tesisi ini adalah pengesanan kelainan bagi pergerakan dinding dengan menggunakan analisa kuantitatif. Analisa gerakan dinding ventrikel kiri secara rutin umumnya berdasarkan tafsiran visual bagi imej ekokardiografi. Penafsiran imej-imej ini sangat bergantung kepada latihan operator dan akur kepada variabilitas yang besar. Bagi mengurangkan variability pemerhatian inter dan intra, pemanfaatan teknik aliran optic menyajikan penganggaran gerakan dinding ventrikel kiri dan menghasilkan gerakan jantung berdasarkan struktur anatomi dinding ventrikel bagi pandangan potongan rentas. Profil ini menyajikan struktur anatomi yang menambahkan maksud tambahan bagi fungsi pengimejan dan menghilangkan keperluan bagi membangunkan set-set data yang besar yang mengandungi parameter spesifik pesakit bagi mendapatkan diagnosis yang tepat. Sebagai tambahan, segmentasi dibahagikan kepada tiga bahagian bersesuaian dengan tiga koroner arteri utama yang bererti untuk operasi jantung. Sebagai hasil, kaedah ini mencapai anggaran bagi fungsi kawasan miokardial dengan peratusan validasi sebanyak 71.4%, yang mana ia sangat memberangsangkan. Secara kesimpulan, penganggaran
bagi kawasan defomasi miokardial dari eokardiografi intrakardiak dengan menyandarkan pengetahuan anatomi dapat dilaksanakan. Kerja ini boleh menjadi bantuan penting bagi meningkatkan ketepatan diagnostik dan sokongan juga kaedah prognostik bagi penyakit ventrikel kiri.
ACKNOWLEDGEMENTS

First of all, we are grateful to our creator, “ALLAH” for this continuous blessing and kindness that makes this work neither the first nor the last.

Special thanks go to Associate Professor Dr. Rahmita Wirza O.K. Rahmat for the opportunity to work under her supervision and for sharing her great knowledge and experience. Without her guidance, this thesis could not have been completed successfully.

I also want to express my thanks to my thesis committee member, Associate Professor Dr. DM Zamrin, for his great assistance, guidance, explanations and valuable experience in cardiology. Sincere appreciation is also due to members of the supervisory committee, Dr. Lili Nurliana Abdullah and Dr. M. Iqbal Saprin, for their helpful discussions and insightful comments about the research. I am also indebted to the Faculty of Computer Sciences and Information Technology, University Putra, Malaysia for providing all sorts of facilities to accomplish this project.

I convey special thanks to Dr. Ting Chin Kuan (lecturer and consultant cardiologist), Dr. Suhaini Kadiman (Consultant Anaesthesiologist) and Ms. Norlaila binti Danuri (cardiac technologist) for their constructive advice, medical knowledge, and evaluation, and for finding time in their busy schedules for my work. I am also grateful to the Medical Centre of University Kebangsaan, Malaysia (UKM) for its invaluable contribution in providing the echocardiograph images required to accomplish this work.
I am deeply and forever grateful to my parents for their love, support and encouragement throughout my entire life. I am also very grateful to my brother and his family for their continuous support and cooperation during the entire period of this study.

Especially, sincere thanks to my husband for his unbelievable support, encouragement, help, and love. During the work on this thesis, he helped me in different ways in implementing and writing.

Finally, I would like to send my deep appreciations to my lovely daughter “Lara” who brought me up with love.
I certify that a thesis Examination Committee has met on **14 October 2010** to conduct the final examination of Zinah Rajab Hussein on her thesis entitled “Pre-processing Edge Detection Image Enhancement and Spatial Object Velocity Estimation for Echocardiograph Diagnostic Test” in accordance with the Universities and University College ACT19971 and the Constitution of the Universiti Putra Malaysia [P.U. (A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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I declare that the thesis is my original work except for quotations and citations, which have been duly acknowledged. I also declare that it has not been previously, and is not currently submitted for any other degree at University Putra Malaysia or other institutions.

Signed

ZINAH RAJAB HUSSEIN

Date: 14 October 2010
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