



**UNIVERSITI PUTRA MALAYSIA**

***IMAGE SEGMENTATION METHOD FOR BOUNDARY DETECTION  
OF BREAST THERMOGRAPHY USING RANDOM WALKERS***

**MEHRDAD MOGHBEL**

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BERILMU BERBAKTI

**IMAGE SEGMENTATION METHOD FOR BOUNDARY DETECTION OF  
BREAST THERMOGRAPHY USING RANDOM WALKERS**

By

**MEHRDAD MOGHBEL**

**Thesis submitted to the school of graduate studies, Universiti Putra Malaysia**

**In fulfillment of the requirement for the degree of Master of Science**

**September 2013**

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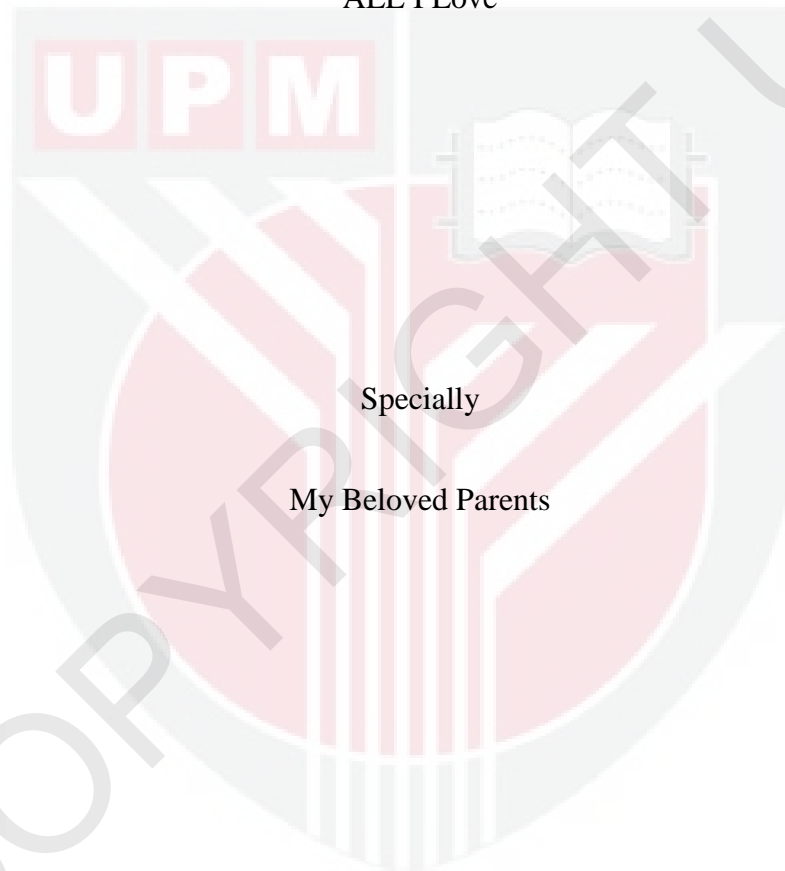
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## DEDICATION

This thesis is dedicated to

ALL I Love



Specially

My Beloved Parents

And

My Friends

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

**IMAGE SEGMENTATION METHOD FOR BOUNDARY DETECTION OF BREAST THERMOGRAPHY USING RANDOM WALKERS**

By

**MEHRDAD MOGHBEL**

**September 2013**

**Chairman: Syamsiah Bint Mashohor, PhD**

**Faculty: Institute of Advanced Technology**

In breast thermography diagnostic, proper detection and segmentation of the areola area as well as detection of breast boundaries present the biggest challenge. As the boundaries of breasts especially in the upper quadrants are usually not present, this produces a great deal of challenge to segment breasts automatically resulting in the majority of the segmentation work done by operator. Although almost half of all breast cancers occur in the upper outer region of the breast known as the tail of the breast, most of the segmentation methods cannot segment the upper outer region of the breast with the adequate accuracy.

Image segmentation approaches are usually based on the identification of characteristics or features of the object and leveraging on them to achieve a proper segmentation. In breast thermography the lack of defined edges on the upper boundaries of the breast and the fact that breasts have different shape, size and characteristics even between breasts of a single individual, makes segmentation of breasts a difficult task for most segmentation methods.

In this thesis, a new framework for segmentation of breast and the areola is introduced and discussed. Unlike other segmentation methods, random walkers showed great tolerance for irregular heat patterns present on the image and in most cases the segmented images corresponds perfectly with the anatomical shape of the breasts. The random walkers was the only segmentation method in the literature capable of segmenting the axillary region of the breast.

All images used for this study were captured by state of the art forward looking infrared (FLIR) thermal cameras and have good resolution and sensitivity. The developed algorithm needs no human intervention until the final result is displayed to the user, if the user is not satisfied with the segmentation results he/ she can appoint new seeds interactively to fine tune the segmentation.

The performance of the proposed method was evaluated by a board of three professional radiologists and the final decision was based on the majority agreement. The segmentation was based on constant parameters among all images used in the study; these standard segmentation parameters achieved acceptable results in most cases. Nevertheless the proposed method was able to surpass the highest accuracy reported within the literature. Use of interactive segmentation can further enhance these results dramatically as all the standard images that were not segmented correctly by the automatically method were correctly segmented after the utilization of the interactive mode.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

**IMEJ SEGMENTASI UNTUK PENGESANAN SEMPADAN TERMOGRAFI  
PAYUDARA BERDASARKAN PEJALAN RAWAK**

**Oleh**

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Dalam diagnosis termografi payudara, pengecaman yang bersesuaian dan segmentasi kawasan areola serta pengecaman sempadan-sempadan payudara merupakan cabaran yang terbesar. Oleh kerana sempadan-sempadan payudara terutamanya di bahagian sukuan atas yang biasanya tidak jelas, ini memberikan cabaran yang tinggi untuk mensegmentasi payudara secara automatik menyebabkan majoriti daripada kerja segmentasi dilaksanakan oleh operator. Walaupun hampir separuh daripada semua kanser payudara berlaku di kawasan atas di luar payudara yang dikenali sebagai ekor dada, kebanyakan daripada kaedah-kaedah segmentasi tidak dapat mensegmentasi kawasan atas di luar payudara ini dengan ketepatan yang dikehendaki.

Pendekatan-pendekatan segmentasi imej biasanya berdasarkan pada pengenalpastian ciri-ciri atau sifat-sifat objek dan memanfaatkan kaedah tersebut untuk mendapatkan segmentasi yang bersesuaian. Dalam termografi payudara, kekurangan takrifan bahagian tepi di sempadan-sempadan atas payudara dan fakta bahawa payudara

mempunyai bentuk, saiz dan ciri-ciri yang berlainan walaupun antara dua payudara seseorang individu, membuatkan segmentasi payudara satu tugas yang sukar, untuk kebanyakan kaedah-kaedah segmentasi. Banyak kaedah telah dibangunkan seperti Snakes, segmentasi berasaskan jelmaan Hough, segmentasi imej secara morfologikal dan segmentasi kelengkungan berpangkalan, tetapi kaedah-kaedah ini gagal untuk mengesan sempadan-sempadan dada dengan tahap ketepatan dikehendaki terutama sempadan-sempadan atas dada.

Dalam tesis ini, satu rangka kerja yang baru untuk mensegmentasi payudara dan areola diperkenalkan dan dibincangkan. Tidak seperti kaedah-kaedah segmentasi yang lain, lintasan rawak menunjukkan toleransi yang tinggi untuk corak-corak haba yang tidak sekata yang hadir dalam imej dan dalam kebanyakan kes, imej yang telah disegmentasi berpadanan dengan sempurna dengan bentuk anatomi payudara. Lintasan rawak adalah satu-satunya kaedah segmentasi dalam sorotan kajian yang berupaya mensegmentasi bahagian aksilari pada payudara.

Kesemua imej-imej yang digunakan dalam kajian ini telah diambil menggunakan kamera haba inframerah FLIR dan mempunyai resolusi dan kepekaan yang baik. Algoritma yang dibangunkan tidak memerlukan campur tangan manusia sehinggalah keputusan akhir dipamerkan kepada pengguna, sekiranya pengguna tidak berpuas hati dengan keputusan segmentasi, mereka boleh memilih titik baru secara interaktif untuk menambahbaik segmentasi tersebut.

Prestasi kaedah yang telah dicadangkan ini telah dinilai oleh sebuah lembaga yang terdiri daripada tiga pakar radiologi yang profesional dan keputusan muktamad dibuat berdasarkan persetujuan majoriti. Segmentasi tersebut telah dibuat berdasarkan pada parameter yang diselaraskan dalam kesemua imej yang digunakan



dalam kajian ini; parameter segmentasi yang standard ini menghasilkan keputusan yang boleh diterima dalam kebanyakan kes. Namun begitu kaedah yang telah dicadangkan mampu mengatasi ketepatan tertinggi yang telah dilaporkan dalam sorotan kajian. Penggunaan segmentasi secara interaktif boleh memperbaiki keputusan-keputusan ini secara mendadak memandangkan kesemua imej standard yang tidak disegmentasi dengan betul menggunakan kaedah automatik, telah disegmentasi dengan betul setelah menggunakan mod interaktif.



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At the end I thank my family and friends for their continuing support and believe.

## Approval

I certify that a Thesis Examination Committee has met on 10/09/2013 to conduct the final examination of Mehrdad Moghbel on his thesis entitled " IMAGE SEGMENTATION METHOD FOR BOUNDARY DETECTION OF BREAST THERMOGRAPHY USING RANDOM WALKERS " in accordance with the Universities and University Colleges Act 1971 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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## DECLARATION

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



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**MEHRDAD MOGHBEL**

Date: 10/SEP/2013

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