

**IMPROVEMENT OF CORONARY ANGIOGRAPHY
FOR QUANTITATIVE CORONARY ANALYSIS BY
USING A COMPUTER VISION TECHNIQUE**

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Degree of Master of Philosophy

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University of Moratuwa

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Thesis submitted in partial fulfillment of the requirements for the degree Master of
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DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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ACKNOWLEDGEMENT

First and foremost I consider it is my bounden duty to record here my sincerest gratitude and appreciation to my supervisor, Dr. Lochandaka Ranathunga for his kind cooperation, guidance, and supervision extended throughout this research project. If not for his encouragement and support this project would never have been a reality. I would like to unreservedly thank my co-supervisors Dr. G.R. Constantine from University of Colombo and Associate Professor Dr. N.A. Abdullah from University of Malaya- Malaysia for guiding me to achieve success in this endeavor.

I would like to express my heartfelt thanks to the Vice Chancellor of the University of Moratuwa, the Dean of the Faculty of Information Technology and the Head of the Department of Information Technology, University of Moratuwa for granting me the opportunity to commence my research work at the University of Moratuwa and facilitating me to carry out same successfully. Further, I would be failing in my duty if I do not extend my sincere gratefulness to the Vice Chancellor of the Rajarata University of Sri Lanka, the Dean of the Faculty of Applied Sciences and the Head of the Department of Physical Sciences, Rajarata University of Sri Lanka for granting me two years paid study leave and releasing me from all academic duties in the University, thus allowing me to concentrate fully on my research work during the said two years. Thanks are also due to the Director and staff of the National Science Foundation, Sri Lanka for granting a research scholarship under the grant number NSF/SCH/2013/06 to financially support this effort. Furthermore, I would like to express my indebtedness to the CEO of LK Domain Registry for granting me the Prof. V.K. Samaranayake Research Grant in order to continue my research studies in the University of Malaya, Malaysia.

A special word of thanks should also be extended to the Chairperson of the Ethics Review Committee of the Faculty of Medicine, University of Colombo for issuing the ethical clearance for extracting clinical data needed for validating the results of this study. It is an honor for me to express my sincere gratitude to Mr. V.G. Vimalasena who is the Principal of School of Radiography, National Hospital of Sri

Lanka for facilitating the domain knowledge to make this effort a success. I would like to convey my heartfelt appreciation to Radiographer Mr. R.M. Janaka Thushara Rathnayaka who is attached to the Cath Lab of the Cardiology Unit, National Hospital of Sri Lanka for facilitating me to obtain the necessary resources, conveying domain knowledge and providing valuable clinical experience. His motivation, prompt support and positive response directed the research work towards its success. Moreover, I acknowledge all Radiographers and Cath Lab staff members in the Cardiology Unit of National Hospital of Sri Lanka for providing necessary resources, data and training on clinical procedures. It is also important to highly appreciate Mr. Riyas Mohamed, Radiographer in Durdans Hospital PLC and Cath Lab staff members of Asiri Surgical Hospital PLC for providing the necessary knowledge and data for the experiments. I declare my salutation and admiration for all the esteemed authors, researchers and philosophers for their great theories, researches, publications and ideas, which have helped to enrich this research work.

I would like to thank all the staff members of the University of Moratuwa for their cooperation and commitment extended in various ways in order to make this project a success. The support and motivation provided by my post graduate friends, Mr. A.M.R.R. Bandara, Mr. V. Senthoran and Mrs. N.M. Wagarachchi who are attached to the Faculty of Information Technology, University of Moratuwa too deserves mentioning with a debt of gratitude.

The members of the testing team Mr. K.A.S.N Wijerathna, Mr. D.D. Hewage, Mr. I.K. Sirirathna and Mr. H.A. Haputhanthri too should be acknowledged for the continuous assistance offered to me for data analysis, testing and component integration. I would like to express my appreciation to Mr. S.S. Ratnajeewa for his immense support and contribution to make this thesis a success.

Last but not least, I offer a debt of gratitude to my parents and my sister for all their encouragement and support extended right through this endeavor. Finally, I am grateful to all those who assisted me in numerous ways during the course of this research.

Abstract

Coronary cine-angiography is an invasive medical image modality, which is widely used in Interventional Cardiology for the detection of stenosis in Coronary arteries. Quantitative coronary analysis is one of the demanding areas in medical imaging and in this study a semi automated quantitative coronary analysis method has been proposed. Direct coronary cine-angiogram frames are processed in order to obtain the features of lumen such as, vessel boundary, skeleton and luminal diameter along the vessels' skeleton as the results. The proposed method consists of four main implementation phases namely, pre-processing, segmentation, vessel path tracking and quantitative analysis. The visual quality of the input frames is enhanced within the pre-processing phase. The proposed segmentation phase is implemented based on a spatial filtering and region growing approach. A clinically important vessel region is processed to detect the vessel boundary and skeleton, which is required as prior knowledge for quantitative analysis. Moreover, the vessel diameter is computed while tracking the vessel skeleton path starting from a given seed. The proposed segmentation method possesses 93.73% mean segmentation accuracy and 0.053 mean fallout rate. Moreover, the proposed quantitative analysis method has been validated for assessing its' technical supportability using a clinically approved data set. As a result of that, this proposed method computes the vessel diameter along the vessel skeleton in single pixel gap and develops the ability to determine the diameter stenosis as the quantitative analysis results. Additionally, the clinical feasibility of the proposed method has been validated to emphasize the clinical usability. Moreover, this study can be further extended to make clinical decisions on stenosis through the functional significance of the vasculature by using proper medical image modality like biplane angiography.

Key words: motion stabilization, vessel segmentation, vessel tracking, quantitative coronary analysis

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LIST OF ABBREVIATIONS

Abbreviation	Description
AMB	Acute Marginal Branch
AP	Anterior-Posterior
CA	Coronary Artery
CC	Correlation Coefficient
CCA	Coronary Cine-angiogram
CLAHE	Contrast Limited Adaptive Histogram Equalization
CMRI	Cardiac Magnetic Resonance Imaging
CX	Circumflex Artery
DFT	Discrete Fourier Transform
FFR	Fractional Flow Reserve
GMV	Global Motion Vector
HOG	Histogram based Oriented Gradient
IVUS	Intra-vascular Ultrasound
LAD	Left Anterior Descending Artery
LAO	Left Anterior Oblique
LCA	Left Coronary Artery
LMCA	Left Main Coronary Artery
MR	Median Ramus
MSCT	Multi Slice Computer Tomography

NIR	Near-Infrared
OCT	Optical Coherent Tomography
OMB	Obtuse Marginal Branch
PCI	Percutaneous Coronary Intervention
PDA	Posterior Descending Artery
PET	Positron Emission Tomography
PLV	Posterior Left Ventricular
RAO	Right Anterior Oblique
RCA	Right Coronary Artery
SIFT	Scale Invariant Feature Transform
SP	Septal Perforators
SPECT	Single Photon Emission Computed Tomography
SPT	Skeleton Path Tracker
VDC	Vessel Diameter Calculation

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