بسم الله الرحمن الرحيم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

MONA MAGHRABY

MONTE CARLO SIMULATION AND 3D FINITE ELEMENT ANALYSIS OF THE FEMALE GENITAL ORGANS FOR THE EARLY DETECTION OF CERVICAL CANCER

By

Samar Mohamed Abd El-Fattah Kamel

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Biomedical Engineering and Systems

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2021

MONTE CARLO SIMULATION AND 3D FINITE ELEMENT ANALYSIS OF THE FEMALE GENITAL ORGANS FOR THE EARLY DETECTION OF CERVICAL CANCER

By

Samar Mohamed Abd El-Fattah Kamel

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Biomedical Engineering and Systems

Under the Supervision of

Prof. Dr. Noha S. Hassan

……..

Associate Professor
Systems and Biomedical Engineering
Faculty of Engineering, Cairo University

Dr. Sherif H. El-Gohary

……..

Assistant Professor
Systems and Biomedical Engineering
Faculty of Engineering, Some University

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2021

MONTE CARLO SIMULATION AND 3D FINITE ELEMENT ANALYSIS OF THE FEMALE GENITAL ORGANS FOR THE EARLY DETECTION OF CERVICAL CANCER

By

Samar Mohamed Abd El-Fattah Kamel

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Biomedical Engineering and Systems

Approved by the
Examining Committee

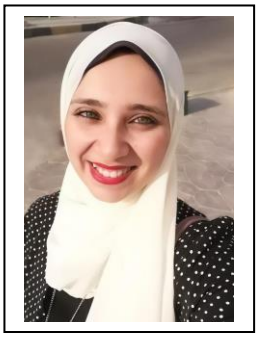
_____
Prof. Dr. Noha S. Hassan, Thesis Main Advisor

_____
Prof. Dr. Ahmed H. Kandil, Internal Examiner

_____
Prof. Dr. Walid Al-Atabany, External Examiner
- Helwan University

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2021

Engineer's Name:	Samar Mohamed Abd El-Fattah Kamel
Date of Birth:	14/9/1991
Nationality:	Egyptian
E-mail:	sabdelfattah.k@gmail.com
Phone:	01116072247
Address:	20 Khaled Amin Street, Haram, Giza
Registration Date:	1/3/2014
Awarding Date:	…./…./2021
Degree:	Master of Science
Department:	Biomedical Engineering and Systems



Supervisors:

Prof. Dr. Noha S. Hassan
Dr. Sherif H. El-Gohary

Examiners:

Prof. Dr. Walid Al-Atabany (External examiner)
- Helwan University
Prof. Dr. Ahmed H. Kandil (Internal examiner)
Prof. Dr. Noha S. Hassan (Thesis main advisor)

Title of Thesis:

Monte Carlo simulation and 3D finite element analysis of the female genital organs for the early detection of cervical cancer.

Key Words:

Cervical Cancer; Monte Carlo; Finite Element Method; Female Genital Organs; Photoacoustic Imaging.

Summary:

We present a complete photoacoustic (PA) analysis for the early detection of cervical cancer using 3D realistic anatomical MRI models of the female genital organs. Models represent a normal healthy cervix and two abnormal cases; early and advanced stages of cancer. Nine constructed 3D models representing FIGO cervical cancer staging were also simulated in this study. Monte Carlo simulations is used to compute fluence maps for the different models at λ = 633 nm. Thermal, structural and acoustical analyses are performed using the FEM. Results showed that there is a significant change in the detected PA signals for abnormal cervix tissues (containing a tumor) as compared to healthy cervix tissues when the transducer was placed trans-vaginally which proves that we are able to differentiate between cancer stages. Thus, results provide insights into using PA imaging for the detection of cancers at early stages.

Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

Name: Samar Mohamed Abd El-Fattah Kamel Date:

Signature:

Dedication

I would like to dedicate this work to every single person who encouraged me once to continue and keep up the good work, to those persons who believed in me, to whom their gentle and kind words were a source of power…

Thank you for your help, encouragement and support.

Samar Mohamed

Acknowledgments

Before and above all, I would like to express my gratitude to **ALLAH; The Absolute Ruler** for paving the way for me to complete this work. The supportive, protective ruler and the governor of all things that without his will, I would not achieve anything.

I consider myself lucky to have worked under the supervision of **Prof. Dr. Noha S. Hassan**. I am greatly thankful for her valuable guidance, precious advice, and sincere encouragement. Words will never be able to express my deepest gratitude.

I owe a lot of thanks to **Dr. sherif H. El-Gohary** for his instructional supervision, continuous support, and patience. His guidance helped and directed me through each stage of the thesis.

I feel most indebted to **Eng. Mohamed Hassan** for his help and support.

I would like to thank each of the following people who greatly helped me on different manners:

- **Dr. Mohamed Mohsen** the radiologist who taught me how to read and understand medical scans.
- **Dr. Moataz El-Sherbiny** the gynecologist who explained to me the anatomy and histology of the female's genitals.
- **Tec. Hamed Hassan** the technician who helped me all the time with any questions regarding the scans and the work performed on them.

I would like to thank the National Cancer Institute and their supportive staff.

I am grateful for the Biomedical Engineering Department and the Rehabilitation and Bionics Lab at Cairo University for allowing me full access to the software programs used to carry out this work.

Finally, I am very grateful for my **Mother** who always encouraged me to complete what I had started to its end and her prayers for me. Great thanks to my **Brothers** who supported me all time during this journey, helped me with things they didn't know before and for them believing in me. I am also very thankful for my **Friends** who always were keeping me up with their kind heart and encouragement words.

Many thanks and Appreciation to all for being part of this journey.
This thesis became possible with all of you.

Table of Contents

List of Tables