AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

Engineering Physics and Mathematics Department

Applications of Modern Optimization Techniques in Inversion of Multilayer Dielectric Media

A Thesis

Submitted in partial fulfillment of the requirements of the degree of

Master of Science in Engineering Mathematics

Submitted by

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STATEMENT

This dissertation is submitted to Ain Shams University for the degree of Master of Science in Engineering Mathematics.

The work included in this thesis was carried out by the author at the Engineering Physics and Mathematics Department, Faculty of Engineering, Ain Shams University, Cairo, Egypt.

No part of this thesis was submitted for a degree or a qualification at any other university or institution.

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ABSTRACT

Amr Mohammad Emad Eldin Abdel Maksoud, Applications of Modern Optimization Techniques in Inversion of Multi Layer Dielectric Media, Master of Science dissertation, Ain Shams University, 2008.

This dissertation demonstrates the application of a hybrid optimization algorithm of particle swarm optimization and Quasi Newton Optimization method in the problem of inversion of multi layer dielectric slabs.

The dissertation also includes a comparison between Genetic Algorithm and Particle Swarm Optimization and a detailed mathematical analysis of the Particle Swarm Optimization Algorithm. This analysis includes a study of particles trajectories, stochastic convergence analysis and analysis of convergence time.

The algorithm is designed to reconstruct both continuous and discrete dielectric profile slabs. One of the major advantages of the inversion algorithm is that it does not require priori information about the slab permittivity profile. Different reconstruction models are used and comparison has been done between them. The algorithm was applied to both noise free data and noisy data to study the effect of noise on the results. The algorithm is tested for different dielectric slabs showing satisfactory performance, the reconstructed profiles are very close to the original profiles and the algorithm is robust with noise and with the slab profile.

Key words: Electromagnetic Inversion, Dielectric Slabs, Particle Swarm Optimization, Algorithm Analysis, Stochastic Analysis.

ACKNOWLEDGEMENT

I would like to thank my supervisors Prof. Dr. Mohamed Ibrahim Hassan for his continuous guidance, encouragement and help, and Prof. Dr. Essam Abdel-Haleem Hashish for helping me throughout the entire work and teaching me how to be devoted for research. They also taught me how to help others. I would like also to thank them for their patience.

Many Thanks go to my parents. Their patience, care, and love are what made me. I pray to God that I will always be a good faithful son to them. I wish also to thank my wife in being patient with me in the critical time I passed through.

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