AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
CAIRO-EGYPT
Computer and Systems Engineering Department

Graph-Based Approach for Symmetry Detection

A Thesis
Submitted in Partial Fulfillment for the Requirements of the Degree of
Master of Science in Electrical Engineering

Submitted by
Heba Ahmed Attwa Abu-Stait
B.Sc. of Electrical Engineering
(Computer and Systems Engineering)
Ain Shams University, 2004

Supervised by
Prof. Dr. Hazem Abbas
Dr. Mahmoud Ibrahim Khalil
Cairo 2013

Curriculum Vitae

Name of the Researcher	Heba Ahmed Attwa Abu-Stait
Date of Birth	$9^{th}$of April 1983
Place of Birth	Kuwait, Kuwait
First University Degree	B.Sc in Electrical Engineering, Computer and Systems Engineering Department, Ain- Shams University
Date of Degree	June 2004

STATEMENT

This Thesis is submitted to Ain Shams University in partial fulfillment of the degree of Master of Science in Electrical Engineering.

The work included in this thesis was carried out by the author in the department of Computer and Systems Engineering, Ain Shams University.

No part of this Thesis has been submitted for a degree or a qualification at any other university or institute.

Name : Heba Ahmed Attwa Abu-Stait

ABSTRACT

Symmetry detection plays an important role in many applications. One of those applications is detecting symmetries of the Integrated Circuits layouts. Symmetry can be presented excessively in one layout design as it provides high efficiency in the circuit performance. Maintaining the geometrical symmetry of the circuit components during the layout compaction has great impact on analog circuit performance and poses great challenges to analog layout automation. Device matching and symmetry are very important in layout design of high performance analog circuits. The aim of this thesis is to find an efficient solution for detecting symmetry in Integrated Circuits layout. Approaches used to detect IC layout symmetry depend on extracting information from the circuit design. A new approach is presented to detect IC layout symmetry between polygons using image processing. In this thesis, a novel method for detecting symmetry is introduced. Taking advantage of the type of images used of layout designs to have more efficient symmetry detection algorithm.

The algorithm is implemented by C++ and tested using several analog layout designs. The new algorithm is successful in detecting symmetry in layout images compared to other ones. This approach detects translation, scale, rotation and partial symmetries in the IC layout design. In comparison to famous symmetry detection algorithms like SIFT, the new approach succeeds to detect symmetric polygons with higher speed and more accurate results.

ACKNOWLEDGMENT

All praise is due to Allah, Most Merciful, the Lord of the Worlds, Who taught man what he knew not. I would like to thank God Almighty for bestowing upon me the chance, strength and ability to complete this work.

First of all, I wish to express my gratitude to my supervision committee for their exceptional guidance, encouragement, insightful thoughts and useful discussions. It was my great pleasure to work with Professor Hazem Abbas and Dr Mahmoud Khalil. I am extremely grateful to Professor Hazem for his continuous support and patience. I am in great debt to Dr Mahmoud for being under his mentorship.

Second, I would like to thank Mohammed Omar for his support and help in all the mathematical proofs in this thesis and numerous technical conversations that we had regarding different topics. I would also like to thank Sherif Hany and Yasmine Badr for their continuous support and enthusing help and very helpful comments.

In addition, a big thank you goes to many friends who supported me at various stages of this work. Special thanks must be addressed to Hazem Said, Eman Tarek, Amr Helal, Mahmoud Khairy, Zeinab Ali, Mai Ali and Basma El-ahmady who helped me a lot in getting many of the resources and developing the target system during the research. I would like to thank Walaa Ashraf and Marwa Shafee for their help in the creation and formating of this thesis in LYX.

Finally, I would like to express my gratitude and love to my parents, sister and brother for their endless support and help all the time.

Contents

List of Figures