



شبكة المعلومات الجامعية

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ





شبكة المعلومات الجامعية



شبكة المعلومات الجامعية

التوثيق الالكتروني والميكرو فيلم

جامعة عين شمس

التوثيق الالكتروني والميكرو فيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأفلام قد اعدت دون أية تغيرات



يجب أن

تحفظ هذه الأفلام بعيداً عن الغبار

في درجة حرارة من 15 – 20 مئوية ورطوبة نسبية من 20-40 %

To be kept away from dust in dry cool place of
15 – 25c and relative humidity 20-40 %



شبكة المعلومات الجامعية



بعض الوثائق الأصلية تالفة



شبكة المعلومات الجامعية



بالرسالة صفحات
لم ترد بالأصل

SHAPE ENERGY MATCHING USING DEFORMABLE TEMPLATES

By

Eng. Youssef Salah Tawfik Ibrahim
Research Assistant
Electronics Research Institute

**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
COMPUTER ENGINEERING**

Under the Supervision of

Prof. Dr. Samir I. Shaheen

**Computer Engineering Dept.,
Cairo University**

Prof. Dr. Nadia H. Hegazi

**The Electronics Research
Institute**

Prof. Dr. Ahmed M. Darwish

**Computer Engineering Dept.,
Cairo University**

**FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
September 1999**

B
1-007

SHAPE ENERGY MATCHING USING DEFORMABLE TEMPLATES

By

Eng. Youssef Salah Tawfik Ibrahim
Research Assistant
Electronics Research Institute

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
COMPUTER ENGINEERING

Approved by the
Examining Committee

Prof. Dr. Samir Ibrahim Shaheen, Thesis Main Advisor

Prof. Dr. Nadia Hamed Hegazi, Thesis Advisor

Prof. Dr. Ahmed Mahmoud Darwish, Thesis Advisor

Prof. Dr. Mohamed Abd El Hamid Ismail, Member

Prof. Dr. Magdy Fekry Ragaey, Member

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
September 1999

Y. S. J. C. 1. 1. 1.

Acknowledgments

I would like to acknowledge all the people who have assisted me during the years of my graduate study at Cairo University. I am the most grateful to my advisors, Prof. Samir Shahin and Prof. Nadia Hegazi, for their professional and personal advice and guidance. They have provided me with numerous valuable ideas, insights, and comments. They have also been very understanding and supportive. I am very fortunate to have them as my advisors. I would also like to thank Dr. Ahmed Darwish for his many insightful discussions. He has also exposed me to a rich literature of deformable template-related work. He has always been available to me to discuss ideas and concepts in computer vision and learning.

My sincere thanks go to all the members of my family. I am very grateful to my parents for their never-fading love, care, understanding, and encouragement. I could have accomplished nothing without their love and support. I would like to dedicate this dissertation to them. I would also like to thank my sisters and brothers for their support.

My colleagues at the ERI have provided help and moral support. I would like to thank them for their interests and concerns.

Abstract

Snakes, or active contours, have been previously used in computer vision applications to locate and identify objects. However, problems associated with initialization, poor convergence to boundary concavities and high computational complexity, have limited their utility. In this thesis, we have proposed and implemented a general non-occluded object localization and classification scheme using deformable templates. Prior knowledge of an object shape is described by an

The shape variations in an object class are achieved by combining a stable, invariant and unique contour model with Markov random field. The deformed shape contour then interacts with the input image via a directional edge potential field calculated from the salient edge features. A Bayesian scheme, which is based on the prior knowledge and the edge information in the input image, is employed to find a match between the deformed template and objects in the image.

To avoid the high computational complexity, a coarse-to-fine algorithm was implemented in an efficient hierarchical fashion. We have successfully applied the suggested algorithm for the detection and classification of industrial parts. Results show that the scheme is very robust with respect to scale, position and orientation changes of the objects as well as noise and local deformations of the shape.

CONTENTS

	Page
LIST OF FIGURES	ix
ACKNOWLEDGEMENTS	iv
ABSTRACT	v
1 INTRODUCTION	1
1.1 Motivation	2
1.2 Problem Statement	3
1.3 Challenges	3
1.4 Summery of Approach	4
1.5 Contributions	6
1.6 Thesis Overview	7
2 LITERATURE SURVEY	9
2.1 Rigid Template Matching	10
2.1.1 Correlation-based Matching	12
2.1.2 Hough Transform	14
2.2 Deformable Models	17
2.2.1 Free-form Deformation Models	19
2.2.1.1 Active Contours	19
2.2.1.2 Optimal Active Region	20
2.2.2 Parametric Deformation Models	24
2.2.2.1 Analytical Form-based Parametric Deformable Models	26
2.2.2.2 Prototype-based Parametric Deformable Models	30
2.2.2.3 Shape Modeling and Learning	32

2.3	Discussion	34
3	DEFORMABLE MODELS IN BAYESIAN FRAMEWORK	36
3.1	Bayes' Theorem	36
3.2	Bayesian Formulation for Deformable Models	37
3.2.1	Free-form Deformable Models	39
3.2.2	Analytical Form-based Parametric Deformation Models	40
3.2.3	Prototype-based Parametric Deformation Models	41
3.3	Discussion	42
4	A DEFORMABLE CONTOUR MODEL	43
4.1	Introduction	43
4.2	Energy Formulation	47
4.3	Bayesian Formulation and Objective Function	49
4.3.1	Prior Distribution	49
4.3.2	Likelihood	51
4.3.3	Posterior Probability Density	53
4.3.4	Objective Function	54
4.3.5	Minimization Algorithm	55
4.4	Discussion	57
5	MULTI-RESOLUTION ALGORITHM FOR LOCALIZATION & IDENTIFICATION	60
5.1	Multi-resolution Algorithm	61
5.2	A Two-stage Recognition Algorithm	62
5.2.1	Searching Using Simple Shape Features	62
5.2.2	Invariant Moments	63
5.2.3	Refinement Using Deformable Template Matching	65
5.2.4	Algorithm	66