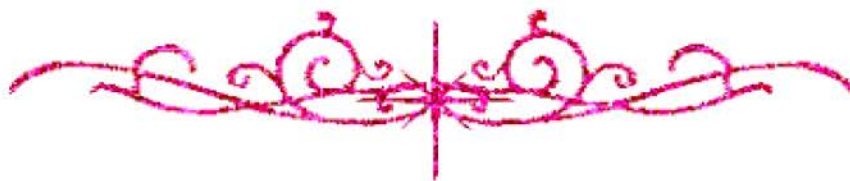


بسم الله الرحمن الرحيم





شبكة المعلومات الجامعية التوثيق الالكتروني والميكروفيلم



جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

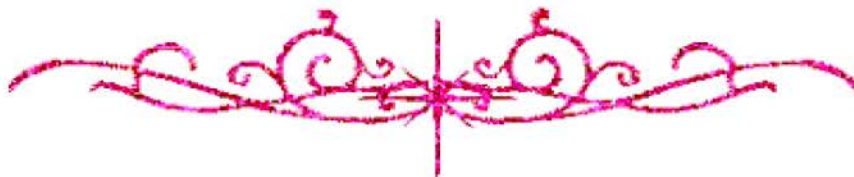
قسم

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



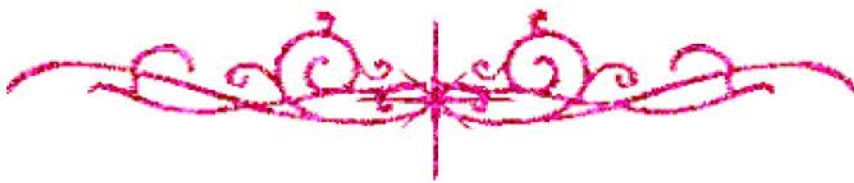
يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار



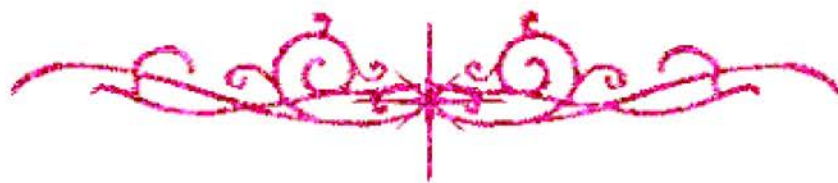


بعض الوثائق الأصلية تالفة





بالرسالة صفحات
لم ترد بالأصل



**NEW CONSIDRATIONS FOR AUTOMATED
GENERALIZATION PROCESS IN THE CONTEXT OF
GIS**

B 17 ✓ E E
by

Wessam Hussein Abdelghani

A Thesis Submitted to the
Faculty of Engineering at Cairo University
In Partial Fulfillment of the
Requirement for the Degree of
MASTER OF SCIENCE
in
CIVIL ENGINEERING

Under the Supervision of

Prof. Dr. Mohamed Shawki Elghazali
Prof. of Surveying and Photogrammetry
Faculty of Engineering
Cairo University

Dr. Ashraf Nasr Sayed
Assist. Prof. of Surveying
and Photogrammetry
Faculty of Engineering
Cairo University

Dr. Yasser Elmanadili
Assist. Prof. of Surveying
and Photogrammetry
Faculty of Engineering
Cairo University

**FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
November 2000**

**NEW CONSIDRATIONS FOR AUTOMATED
GENERALIZATION PROCESS IN THE CONTEXT OF
GIS**

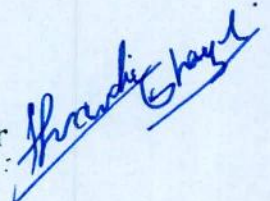
by

Wessam Hussein Abdelghani

A Thesis Submitted to the
Faculty of Engineering at Cairo University
In Partial Fulfillment of the
Requirement for the Degree of
MASTER OF SCIENCE
in
CIVIL ENGINEERING

**Approved by the
Examining Committee:**

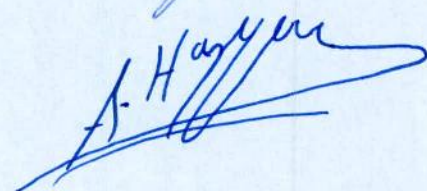
Prof. Dr. Mohamed Shawki Elghazali, Thesis Main Advisor



Prof. Dr. Mostafa Ahmed Baraka, Member



Prof. Dr. Adel Youssef Hagag, Member



Y. I. Abdel-Aziz

**FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
November 2000**

ACKNOWLEDGMENTS

I would like to express my deepest thanks and appreciation to Prof. Dr. M. Shawki Elghazali, for his help, valuable discussions, and suggestions in this research.

Also, I would like to express my deepest gratitude and sincere thanks to Dr. Ashraf Nasr and Dr. Yasser Elmanadili, for their continuous assistance, technical support and valuable help in this research.

Also, the greatest thanks for Prof. Dr. Youssef Ibrahim Abdelaziz, for his great effort, help, and encouragement during my research.

Grateful acknowledgments and appreciation are extended to all the staff of surveying department at Cairo University.

ABSTRACT

The lack of digital maps at different scales is considered an impediment for GIS applications due to the high cost of the conversion process and the absence of automated **Generalization** tools. Hence, the conversion process is repeated for each scale and, the attribute database is rebuilt to be relevant to the geometric modifications due to scale change.

Many researchers have exerted a lot to solve the automated **Generalization** problem but they focus on specific topics (linear features, some range of scales, and some types of maps). Most of researchers have approached the problem from cartographic point of view, however, if we deal with automated **Generalization** from the GIS point of view, new dimensions will appear and the problems will be different. Through GIS environment and the assistance of object oriented programming tools and with new expert systems techniques, the automated **Generalization** problem could be simplified.

In this research, the automated **Generalization** process is discussed in the GIS context. Past and present attempts are shown. New approaches and future trends are studied. Two existing automated **Generalization** systems are discussed. Also proposed solutions are presented. Finally an experiment for automating the generalization process is executed, and the results are discussed. The whole effort could be seen as an attempt towards comprehensive solution for automated **Generalization** process.

List of Contents

Acknowledgments	i
Abstract	ii
List of Contents	iii
List of Tables	vii
List of Figures	viii
1 Introduction	1
1.1 General	1
1.2 Scope and objectives of research	2
1.3 Literature organization	3
2 Literature review	4
2.1 Cartography overview	4
2.1.1 Map classification	4
2.1.2 Type of maps	5
2.1.3 Representation of physical and artificial features	8
2.1.4 Map design	9
2.2 Generalization process classification	10
2.2.1 Manual generalization	10
2.2.2 Automated generalization	12
2.2.3 Automated cartographic generalization	12
2.2.4 Model-oriented generalization	12
2.3 Past and present attempts for automated generalization	13

2.3.1	Specific generalization	13
2.3.2	Batch generalization	14
2.3.3	Interactive generalization	15
2.4	Future trends of automated generalization	16
2.4.1	New conceptual spatial database models	16
2.4.2	Knowledge-based approaches	17
2.4.3	Model generalization	22
2.5	Evaluation of automated generalization	23
2.5.1	Tasks involved in the evaluation process	23
2.5.2	Quantitative evaluation	24
2.5.3	Qualitative evaluation	25
3	Existing automated generalization systems	26
3.1	MGE map generalizer (cartographic-based generalization)	26
3.1.1	Knowledge acquisition	26
3.1.2	Formalization of generalization process	27
3.1.3	System evaluation	29
3.1.4	System capabilities	30
3.2	MAGE (model-oriented generalization)	38
3.2.1	The used spatial database model (SDS)	38
3.2.2	Major operators of the system	40
4	Generalization in the context of GIS	44
4.1	GIS definition	44
4.1.1	GIS data models	45

4.1.2	Characteristics of spatial data	46
4.1.3	The structure of spatial database	46
4.1.4	GIS and map scale	47
4.2	Generalization and GIS environment	49
4.2.1	Database to map transformation (on display level)	50
4.2.2	Database to database transformation (on analysis level)	50
4.3	Effects of GIS on generalization operators	51
4.4	Proposed approach	53
4.4.1	Definitions	54
4.4.2	Procedures	55
5	Applying automated generalization in the GIS context	63
5.1	Introduction	63
5.2	Experimental work	63
5.2.1	Knowledge acquisition	63
5.2.2	Data used	64
5.2.3	Automation	64
5.3	Evaluation	65
5.3.1	Global measure	66
5.3.2	Geometric measure	66
5.3.3	Attribute measure	66
6	Conclusions and Recommendations	79
6.1	Conclusions	79
6.2	Recommendations	80

List of References	81
Appendix (A) Code lines of elimination operation	83
Appendix (B) Code lines of aggregation operation	85

List of Tables

Table (2-1) Map scale classification	5
Table (2-2) Synopsis of different methods for knowledge acquisition.....	20
Table (4-1) Relation between map scale and Resolution (.5mm spot).....	47
Table (4-2) Relation between map scale and Resolution (.5mm spot).....	48
Table (4-3) Identifying the dominant value.....	61
Table (4-4) Look up table for residential area.....	62
Table (4-5) Look up table for agriculture area.....	62
Table (5-1) Attributes of original data.....	71
Table (5-2) Attributes of aggregated polygons.....	74
Table (5-3) Geometric deviation between generalized and original map.....	77
Table (5-4) Original attributes.....	78
Table (5-5) Generalized attributes.....	78

List of Figures

Figure (3-1) Original data at 1: 24,000 containing hydrography, vegetation, individual Buildings and developed areas.....	31
Figure (3-2) The original vegetation presentation.....	32
Figure (3-3) The vegetation data after initial elimination.....	33
Figure (3-4) Areas that are too narrow were found using area-to-line collapse and Were reduced to linear features.....	34
Figure (3-5) Further elimination removed the linear features shown in fig (3-4) and Other unimportant features.....	35
Figure (3-6) Areas in close distance were aggregated into larger areas.....	36
Figure (3-7) Final result with a scale of 1: 100,000	37
Figure (3-8) A portion of a map and SDS representation	39
Figure (3-9) Scaling of orthogonal object	41
Figure (3-10) The skeletonization of linear object	41
Figure (3-11) Snap merge	42
Figure (4-1) Minimum object size	54
Figure (4-2) Minimum space	54
Figure (4-3) Minimum object's detail	55
Figure (4-4) Chart illustrates the elimination process.....	57
Figure (4-5) A Flow chart shows the aggregation procedures for N polygons....	58
Figure (4-6) A Flow chart shows the aggregation procedures between two Polygons P_s of N vertices and P_Q of M segments	59
Figure (4-7) The cases included in the aggregation approach	60