TITLE IN CAPITAL LETTERS

TITLE IN CAPITAL LETTERS

TITLE IN CAPITAL LETTERS

TITLE IN CAPITAL LETTERS

AMIRAH MUHAMMAD IMRAN

UNIVERSITI TEKNOLOGI MALAYSIA

PSZ 19:16 (Pind. 1/13)

UNIVERSITI TEKNOLOGI MALAYSIA

DECLARATION OF THESIS / UNDERGRADUATE PROJECT REPORT AND COPYRIGHT

Author’s full name :

Date of Birth :

Title :

Academic Session :

I declare that this thesis is classified as:

|  |  |  |
| --- | --- | --- |
|  | CONFIDENTIAL | (Contains confidential information under the Official Secret Act 1972)\* |
|  |  |  |
|  | RESTRICTED | (Contains restricted information as specified by the organization where research was done)\* |
|  |  |  |
| ✓ | OPEN ACCESS | I agree that my thesis to be published as online open access (full text) |

1. I acknowledged that Universiti Teknologi Malaysia reserves the right as follows:
2. The thesis is the property of Universiti Teknologi Malaysia
3. The Library of Universiti Teknologi Malaysia has the right to make copies for the purpose of research only.
4. The Library has the right to make copies of the thesis for academic exchange.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  | Certified by: |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  | SIGNATURE OF STUDENT |  | SIGNATURE OF SUPERVISOR |  |
|  |  |  |  |  |
|  | 791601-01-8899 |  | DR. SITI HAJAR OTHMAN |  |
|  | **MATRIX NUMBER** |  | **NAME OF SUPERVISOR** |  |
|  |  |  |  |  |
|  | Date: 9 MAY 2019 |  | Date: 9 MAY 2019 |  |

NOTES : If the thesis is CONFIDENTIAL or RESTRICTED, please attach with the letter from the organization with period and reasons for confidentiality or restriction

“I hereby declare that we have read this thesis and in my

opinion this thesis is suffcient in term of scope and quality for the

award of the degree of Bachelor of Computer Science (Network & Security)”

|  |  |  |
| --- | --- | --- |
| Signature | : | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Name of Supervisor | : | SITI HAJAR OTHMAN |
| Date | : | 9 May 2019 |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

ON-LINE RECOGNITION OF DEVELOPING CONTROL CHART PATTERNS

AMIRAH MUHAMMAD IMRAN

A thesis submitted in fulfilment of the

requirements for the award of the degree of

Bachelor of Computer Science (Network & Security)

School of Computing

Faculty of Engineering

Universiti Teknologi Malaysia

MAY 2019

DECLARATION

I declare that this thesis entitled *“On-Line Recognition of Developing Control Chart Patterns”* is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

|  |  |  |
| --- | --- | --- |
| Signature | : | .................................................... |
| Name | : | AMIRAH MUHAMMAD IMRAN |
| Date | : | 9 May 2019 |
|  |  |  |
|  |  |  |

DEDICATION

This thesis is dedicated to my father, who taught me that the best kind of knowledge to have is that which is learned for its own sake. It is also dedicated to my mother, who taught me that even the largest task can be accomplished if it is done one step at a time.

ACKNOWLEDGEMENT

In preparing this thesis, I was in contact with many people, researchers, academicians, and practitioners. They have contributed towards my understanding and thoughts. In particular, I wish to express my sincere appreciation to my main thesis supervisor, Professor Dr. XX, for encouragement, guidance, critics and friendship. I am also very thankful to my co-supervisor Professor Dr YY and Associate Professor Dr. ZZZ for their guidance, advices and motivation. Without their continued support and interest, this thesis would not have been the same as presented here.

My fellow student should also be recognised for their support. My sincere appreciation also extends to all my colleagues and others who have provided assistance at various occasions. Their views and tips are useful indeed. Unfortunately, it is not possible to list all of them in this limited space. I am grateful to all my family member.

ABSTRACT

The purpose of this study is to investigate the application of genetic algorithm (GA) in modelling linear and non-linear dynamic systems and develop an alternative model structure selection algorithm based on GA. Orthogonal least square (OLS), a gradient descent method was used as the benchmark for the proposed algorithm. A model structure selection based on modified genetic algorithm (MGA) has been proposed in this study to reduce problems of premature convergence in simple GA (SGA). The effect of different combinations of MGA operators on the performance of the developed model was studied and the effectiveness and shortcomings of MGA were highlighted. Results were compared between SGA, MGA and benchmark OLS method. It was discovered that with similar number of dynamic terms, in most cases, MGA performs better than SGA in terms of exploring potential solution and outperformed the OLS algorithm in terms of selected number of terms and predictive accuracy. In addition, the use of local search with MGA for fine-tuning the algorithm was also proposed and investigated, named as memetic algorithm (MA). Simulation results demonstrated that in most cases, MA is able to produce an adequate and parsimonious model that can satisfy the model validation tests with significant advantages over OLS, SGA and MGA methods. Furthermore, the case studies on identification of multivariable systems based on real experiment t al data from two systems namely a turbo alternator and a continuous stirred tank reactor showed that the proposed algorithm could be used as an alternative to adequately identify adequate and parsimonious models for those systems. Abstract must be bilingual. For a thesis written in Bahasa Melayu, the abstract must first be written in Bahasa Melayu and followed by the English translation. If the thesis is written in English, the abstract must be written in English and followed by the translation in Bahasa Melayu. The abstract should be brief, written in one paragraph and not exceed one (1) page. An abstract is different from synopsis or summary of a thesis. It should states the field of study, problem definition, methodology adopted, research process, results obtained and conclusion of the research. The abstract can be written using single or one and a half spacing. Example can be seen in Appendix 1 (Bahasa Melayu) and Appendix J (English).

ABSTRAK

Kajian ini dilakukan bertujuan mengkaji penggunaan algoritma genetik (GA)

dalam pemodelan sistem dinamik linear dan tak linear dan membangunkan kaedah alternatif bagi pcmilihan struktur model menggunakan GA. Algorithma kuasa dua terkecil ortogon (OLS), satu kaedah penurunan kecerunan digunakan sebagai bandingan bagi kaedah yang dicadangkan. Pcmilihan struktur model mengunakan kaedah algoritma genetik yang diubahsuai (MGA) dicadangkan dalam kajian ini bagi

mengurangkan masalah konvergens pramatang dalam algoritma genetik mudah (SGA). Kesan penggunaan gabungan operator MGA yang berbeza ke atas prestasi model yang terbentuk dikaji dan keberkesanan serta kekurangan MGA diu t arakan. Kajian simulasi dilakukan untuk membanding SGA, MGA dan OLS. Dengan meggunakan bilangan parametcr dinamik yang setara kajian ini mendapati, dalam kebanyakan kes, prestasi MGA adalah lebih baik daripada SGA dalam mencari penyelesaian yang berpotensi dan lebih berkebolehan daripada OLS dalam menentukan bilangan sebutan yang dipilih dan ketcpatan ramalan. Di samping itu, penggunaan carian tcmpatan dalam MGA untuk menambah baik algorithma tersebut dicadang dan dikaji, dinamai sebagai algoritma mcmetic (MA). Hasil simulasi menunjukkan, dalam kebanyakan kes, MA berkeupayaan menghasilkan model yang bersesuaian dan parsimoni dan mcmenuhi ujian pengsahihan model di samping mcmperolehi beberapa kelebihan dibandingkan dengan kaedah OLS, SGA dan MGA. Tambahan pula, kajian kes untuk sistcm berbilang pcmbolehubah menggunakan data eksperimental sebenar daripada dua sistem iaitu sistem pengulang-alik turbo dan reaktor teraduk berterusan menunjukkan algoritma ini boleh digunakan sebagai alternatif untuk mcmperolehi model termudah yang memadai bagi sistcm tersebut.

TABLE OF CONTENTS

|  |  |  |
| --- | --- | --- |
|  | TITLE | PAGE |

[DECLARATION ii](#_Toc2850081)

[DEDICATION iii](#_Toc2850082)

[ACKNOWLEDGEMENT iv](#_Toc2850083)

[ABSTRACT v](#_Toc2850084)

[ABSTRAK vi](#_Toc2850085)

[TABLE OF CONTENTS vii](#_Toc2850086)

[LIST OF TABLES ix](#_Toc2850087)

[LIST OF FIGURES x](#_Toc2850088)

[LIST OF ABBREVIATIONS xi](#_Toc2850089)

[LIST OF SYMBOLS xii](#_Toc2850090)

[LIST OF APPENDICES xiii](#_Toc2850091)

[CHAPTER 1 INTRODUCTION 1](#_Toc2850092)

[1.1 Introduction 1](#_Toc2850093)

[1.2 Problem Background 1](#_Toc2850094)

[1.3 Research Aim 2](#_Toc2850095)

[1.4 Research Question 2](#_Toc2850096)

[1.5 Research Objectives 2](#_Toc2850097)

[1.6 Research Scope 3](#_Toc2850098)

[1.7 Research Contribution 3](#_Toc2850099)

[1.8 Report Organization 3](#_Toc2850100)

[CHAPTER 2 LITERATURE REVIEW 5](#_Toc2850101)

[2.1 Introduction 5](#_Toc2850102)

[2.2 Problem Formulation 6](#_Toc2850103)

[2.2.1 Research Domain 6](#_Toc2850104)

[2.2.2 Description of Related Studies 7](#_Toc2850105)

[2.3 Proposed Solutions 7](#_Toc2850106)

[2.4 Chapter Summary 8](#_Toc2850107)

[CHAPTER 3 RESEARCH METHODOLOGY 9](#_Toc2850108)

[3.1 Introduction 9](#_Toc2850109)

[3.2 Operational Framework/Research Workflow 9](#_Toc2850110)

[3.3 Justification 9](#_Toc2850111)

[3.4 Performance measurement 10](#_Toc2850112)

[3.5 Chapter Summary 10](#_Toc2850113)

[CHAPTER 4 RESEARCH DESIGN AND IMPLEMENTATION 11](#_Toc2850114)

[4.1 Introduction 11](#_Toc2850115)

[4.2 Proposed Solution 11](#_Toc2850116)

[4.3 Experiment Design 11](#_Toc2850117)

[4.4 Parameter and Testing Method 11](#_Toc2850118)

[4.5 Chapter Summary 12](#_Toc2850119)

[CHAPTER 5 RESULTS, ANALYSIS AND DISCUSSION 15](#_Toc2850120)

[5.1 Introduction 15](#_Toc2850121)

[5.2 Research Results and Analysis 15](#_Toc2850122)

[5.3 Future Works 15](#_Toc2850123)

[CHAPTER 6 CONCLUSION 17](#_Toc2850124)

[6.1 Introduction 17](#_Toc2850125)

[6.2 Achievement of Project Objectives 17](#_Toc2850126)

[6.3 Suggestions for Improvement and Future Works 17](#_Toc2850127)

[REFERENCES 19](#_Toc2850128)

LIST OF TABLES

|  |  |  |
| --- | --- | --- |
| TABLE NO. | TITLE | PAGE |

[Table 2.1 Example Repeated Header Table 6](#_Toc2850758)

[Table 2.2 Regression analysis for the results of preliminary feature screening 6](#_Toc2850759)

[Table 2.3 Estimated effects and regression coefficients for the recogniser's performance (reduced model) 6](#_Toc2850760)

[Table 4.1 Regression analysis for the results of preliminary feature screening 13](#_Toc2850761)

[Table A.1 Example Repeated Header Table 22](#_Toc2850762)

LIST OF FIGURES

|  |  |  |
| --- | --- | --- |
| FIGURE NO. | TITLE | PAGE |

[Figure 2.1 Continuous variability reduction using SPC chart (Revelle and Harrington, 1992) 5](#_Toc2850763)

[Figure 3.1 Example of Formatting Method 10](#_Toc2850764)

[Figure A.1 xxxxxxxxxxxxxxxx 21](#_Toc2850765)

LIST OF ABBREVIATIONS

|  |  |  |
| --- | --- | --- |
| ANN | - | Artificial Neural Network |
| GA | - | Genetic Algorithm |
| PSO | - | Particle Swarm Optimization |
| MTS | - | Mahalanobis Taguchi System |
| MD | - | Mahalanobis Distance |
| TM | - | Taguchi Method |
| UTM | - | Universiti Teknologi Malaysia |
| XML | - | Extensible Markup Language |
| ANN | - | Artificial Neural Network |
| GA | - | Genetic Algorithm |
| PSO | - | Particle Swarm Optimization |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

LIST OF SYMBOLS

|  |  |  |
| --- | --- | --- |
| δ | - | Minimal error |
|  | - | Diameter |
|  | - | Force |
|  | - | Velocity |
|  | - | Pressure |
|  | - | Moment of Inersia |
|  | - | Radius |
|  | - | Reynold Number |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

LIST OF APPENDICES

|  |  |  |
| --- | --- | --- |
| APPENDIX | TITLE | PAGE |

[Appendix A Mathematical Proofs 21](#_Toc2850771)

[Appendix B Psuedo Code 23](#_Toc2850772)

[Appendix C Time-series Results Long 24](#_Toc2850773)

# INTRODUCTION

## Introduction

Video provides a powerful way to help you prove your point. When you click Online Video, you can paste in the embed code for the video you want to add. You can also type a keyword to search online for the video that best fits your document. To make your document look professionally produced, Word provides header, footer, cover page, and text box designs that complement each other. For example, you can add a matching cover page, header, and sidebar. *“For the first paragraph, use ‘Para 2 lines’ style”*

Video provides a powerful way to help you prove your point. When you click Online Video, you can paste in the embed code for the video you want to add. You can also type a keyword to search online for the video that best fits your document. To make your document look professionally produced, Word provides header, footer, cover page, and text box designs that complement each other. For example, you can add a matching cover page, header, and sidebar. Click Insert and then choose the elements you want from the different galleries. Themes and styles also help keep your document coordinated. When you click Design and choose a new Theme, the pictures, charts, and SmartArt graphics change to match your new theme. “For the last paragraph/single paragraph in the section, use ‘Para 4 lines’ style”

## Problem Background

Video provides a powerful way to help you prove your point. When you click Online Video, you can paste in the embed code for the video you want to add. You can also type a keyword to search online for the video that best fits your document. To make your document look professionally produced, Word provides header, footer, cover page, and text box designs that complement each other. For example, you can add a matching cover page, header, and sidebar. Click Insert and then choose the elements you want from the different galleries.

Themes and styles also help keep your document coordinated. When you click Design and choose a new Theme, the pictures, charts, and SmartArt graphics change to match your new theme. When you apply styles, your headings change to match the new theme. Save time in Word with new buttons that show up where you need them. To change the way a picture fits in your document, click it and a button for layout options appears next to it. When you work on a table, click where you want to add a row or a column, and then click the plus sign.

## Research Aim

Research aim shows what you plan to achieve in one sentence.

## Research Question

Research aim shows what you plan to achieve in one sentence.

## Research Objectives

The objectives of the research are:

1. To estimate the parameters
2. Item 1
3. Item 2
4. To define the best parameter estimate.

## Research Scope

The scopes of the research are:

1. Scope 1
2. Scope 2

## Research Contribution

Themes and styles also help keep your document coordinated. When you click Design and choose a new Theme, the pictures, charts, and SmartArt graphics change to match your new theme. When you apply styles, your headings change to match the new theme. Save time in Word with new buttons that show up where you need them. To change the way a picture fits in your document, click it and a button for layout options appears next to it. When you work on a table, click where you want to add a row or a column, and then click the plus sign.

## Report Organization

Themes and styles also help keep your document coordinated. When you click Design and choose a new Theme, the pictures, charts, and SmartArt graphics change to match your new theme. When you apply styles, your headings change to match the new theme. Save time in Word with new buttons that show up where you need them. To change the way a picture fits in your document, click it and a button for layout options appears next to it. When you work on a table, click where you want to add a row or a column, and then click the plus sign.

# LITERATURE REVIEW

## Introduction

Video provides a powerful way to help you prove your point. When you click Online Video, you can paste in the embed code for the video you want to add. You can also type a keyword to search online for the video that best fits your document. To make your document look professionally produced, Word provides header, footer, cover page, and text box designs that complement each other. For example, you can add a matching cover page, header, and sidebar.

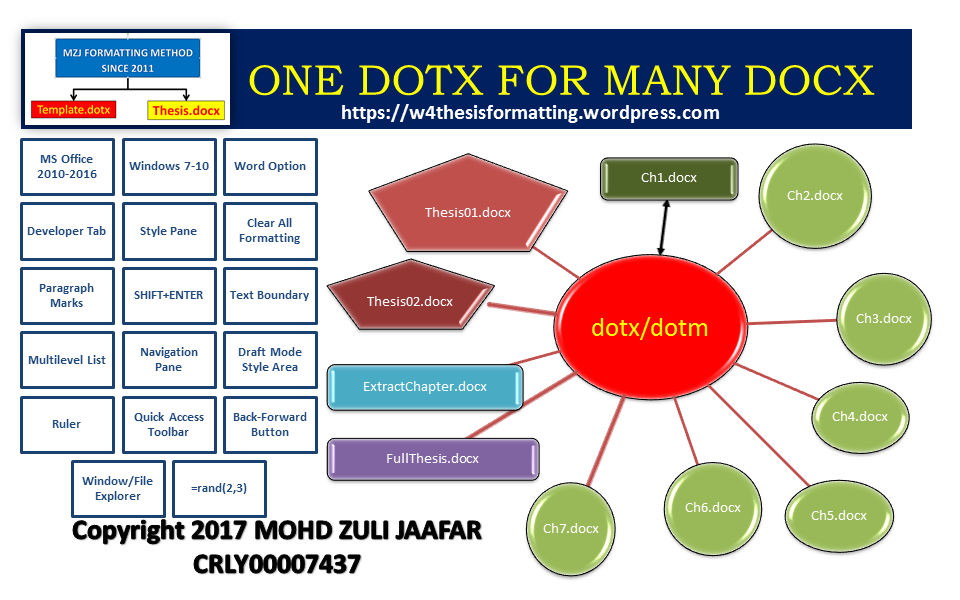


Figure 2.1 Continuous variability reduction using SPC chart (Revelle and Harrington, 1992)

Table 2.1 Example Repeated Header Table

| Title | Title | Title | Title |
| --- | --- | --- | --- |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

Table .2 Regression analysis for the results of preliminary feature screening

Table .3 Estimated effects and regression coefficients for the recogniser's performance (reduced model)

Video provides a powerful way to help you prove your point. When you click Online Video, you can paste in the embed code for the video you want to add. You can also type a keyword to search online for the video that best fits your document. To make your document look professionally produced, Word provides header, footer, cover page, and text box designs that complement each other. For example, you can add a matching cover page, header, and sidebar.

## Problem Formulation

Study of domain from general to specific, related studies, a description of the identified problem.

### Research Domain

Video provides a powerful way to help you prove your point. When you click Online Video, you can paste in the embed code for the video you want to add. You can also type a keyword to search online for the video that best fits your document. To make your document look professionally produced, Word provides header, footer, cover page, and text box designs that complement each other. For example, you can add a matching cover page, header, and sidebar.

### Description of Related Studies

After deliberating on doctoral education in Australia in the 1990s, one observer I Australia writes:

The lack of any significant formal course work within our Ph.D. and master degrees by research has continued for three decades. The focus of our Ph.D. research type degrees continues to be the research project, and this is almost the only medium by which education is accomplished.

(Stranks, 1984:171)

## Proposed Solutions

Study of theory/algorithm/method that can contribute towards solving the problem, Justification of chosen theory/algorithm/method, Every sub-topic within the domain must have a review.

|  |  |
| --- | --- |
|  | (2.1) |

To change the way a picture fits in your document, click it and a button for layout options appears next to it. When you work on a table, click where you want to add a row or a column, and then click the plus sign. Reading is easier, too, in the new Reading view. You can collapse parts of the document and focus on the text you want. If you need to stop reading before you reach the end, Word remembers where you left off - even on another device. Video provides a powerful way to help you prove your point. When you click Online Video, you can paste in the embed code for the video you want to add. You can also type a keyword to search online for the video that best fits your document. To make your document look professionally produced, Word provides header, footer, cover page, and text box designs that complement each other. For example, you can add a matching cover page, header, and sidebar.

## Chapter Summary

Video provides a powerful way to help you prove your point. When you click Online Video, you can paste in the embed code for the video you want to add. You can also type a keyword to search online for the video that best fits your document. To make your document look professionally produced, Word provides header, footer, cover page, and text box designs that complement each other. For example, you can add a matching cover page, header, and sidebar.

# RESEARCH METHODOLOGY

## Introduction

On the Insert tab, the galleries include items that are designed to coordinate with the overall look of your document. You can use these galleries to insert tables, headers, footers, lists, cover pages, and other document building blocks. When you create pictures, charts, or diagrams, they also coordinate with your current document look. You can easily change the formatting of selected text in the document text by choosing a look for the selected text from the Quick Styles gallery on the Home tab.

## Operational Framework/Research Workflow

On the Insert tab, the galleries include items that are designed to coordinate with the overall look of your document. You can use these galleries to insert tables, headers, footers, lists, cover pages, and other document building blocks. When you create pictures, charts, or diagrams, they also coordinate with your current document look. You can easily change the formatting of selected text in the document text by choosing a look for the selected text from the Quick Styles gallery on the Home tab.

## Justification

On the Insert tab, the galleries include items that are designed to coordinate with the overall look of your document. You can use these galleries to insert tables, headers, footers, lists, cover pages, and other document building blocks. When you create pictures, charts, or diagrams, they also coordinate with your current document look. You can easily change the formatting of selected text in the document text by choosing a look for the selected text from the Quick Styles gallery on the Home tab.

## Performance measurement

On the Insert tab, the galleries include items that are designed to coordinate with the overall look of your document. You can use these galleries to insert tables, headers, footers, lists, cover pages, and other document building blocks.

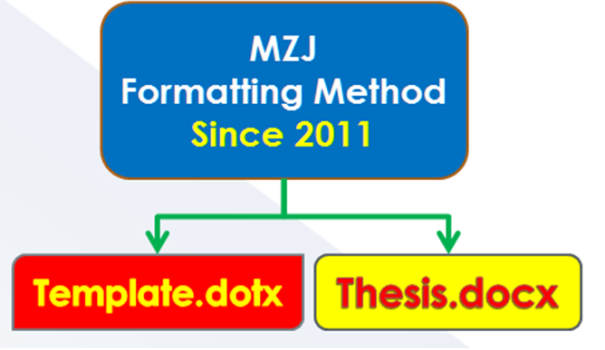


Figure 3.1 Example of Formatting Method

## Chapter Summary

Video provides a powerful way to help you prove your point. When you click Online Video, you can paste in the embed code for the video you want to add. You can also type a keyword to search online for the video that best fits your document. To make your document look professionally produced, Word provides header, footer, cover page, and text box designs that complement each other. For example, you can add a matching cover page, header, and sidebar.

# RESEARCH DESIGN AND IMPLEMENTATION

## Introduction

Video provides a powerful way to help you prove your point. When you click Online Video, you can paste in the embed code for the video you want to add. You can also type a keyword to search online for the video that best fits your document.

## Proposed Solution

Video provides a powerful way to help you prove your point. When you click Online Video, you can paste in the embed code for the video you want to add. You can also type a keyword to search online for the video that best fits your document.

## Experiment Design

Video provides a powerful way to help you prove your point. When you click Online Video, you can paste in the embed code for the video you want to add. You can also type a keyword to search online for the video that best fits your document.

## Parameter and Testing Method

Video provides a powerful way to help you prove your point. When you click Online Video, you can paste in the embed code for the video you want to add. You can also type a keyword to search online for the video that best fits your document.

## Chapter Summary

Video provides a powerful way to help you prove your point. When you click Online Video, you can paste in the embed code for the video you want to add. You can also type a keyword to search online for the video that best fits your document.

| Title | Title | Title | Title | Title | Title | Title |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

Table 4. Regression analysis for the results of preliminary feature screening

# RESULTS, ANALYSIS AND DISCUSSION

## Introduction

Video provides a powerful way to help you prove your point. When you click Online Video, you can paste in the embed code for the video you want to add. You can also type a keyword to search online for the video that best fits your document. To make your document look professionally produced, Word provides header, footer, cover page, and text box designs that complement each other. For example, you can add a matching cover page, header, and sidebar.

## Research Results and Analysis

Video provides a powerful way to help you prove your point. When you click Online Video, you can paste in the embed code for the video you want to add. You can also type a keyword to search online for the video that best fits your document. To make your document look professionally produced, Word provides header, footer, cover page, and text box designs that complement each other. For example, you can add a matching cover page, header, and sidebar.

## Future Works

Video provides a powerful way to help you prove your point. When you click Online Video, you can paste in the embed code for the video you want to add. You can also type a keyword to search online for the video that best fits your document. To make your document look professionally produced, Word provides header, footer, cover page, and text box designs that complement each other. For example, you can add a matching cover page, header, and sidebar.

# CONCLUSION

## Introduction

Video provides a powerful way to help you prove your point. When you click Online Video, you can paste in the embed code for the video you want to add. You can also type a keyword to search online for the video that best fits your document. To make your document look professionally produced, Word provides header, footer, cover page, and text box designs that complement each other. For example, you can add a matching cover page, header, and sidebar.

## Achievement of Project Objectives

Video provides a powerful way to help you prove your point. When you click Online Video, you can paste in the embed code for the video you want to add. You can also type a keyword to search online for the video that best fits your document. To make your document look professionally produced, Word provides header, footer, cover page, and text box designs that complement each other. For example, you can add a matching cover page, header, and sidebar.

## Suggestions for Improvement and Future Works

Video provides a powerful way to help you prove your point. When you click Online Video, you can paste in the embed code for the video you want to add. You can also type a keyword to search online for the video that best fits your document. To make your document look professionally produced, Word provides header, footer, cover page, and text box designs that complement each other. For example, you can add a matching cover page, header, and sidebar.

REFERENCES

Chen, M.-C. and Huang, S.-H. (2003) ‘Credit scoring and rejected instances reassigning through evolutionary computation techniques’, *Expert Systems with Applications*, 24(4), pp. 433–441.

Clerc, M. and Kennedy, J. (2002) ‘The particle swarm - explosion, stability, and convergence in a multidimensional complex space’, *IEEE Transactions on Evolutionary Computation*, 6(1), pp. 58–73.

Gosnell, M., Woodley, R., Hicks, J. and Cudney, E. (2014) ‘Exploring the Mahalanobis-Taguchi Approach to Extract Vehicle Prognostics and Diagnostics’, in *Computational Intelligence in Vehicles and Transportation Systems (CIVTS), 2014 IEEE Symposium on*, pp. 84–91.

Gupta, A. (2015) ‘Classification of Complex UCI Datasets Using Machine Learning Algorithms Using Hadoop’, *International Journal of Scetific & Techology Research*, 4(5), pp. 85–94.

Hu, J., Zhang, L., Liang, W. and Wang, Z. (2009) ‘Incipient mechanical fault detection based on multifractal and MTS methods’, *Petroleum Science*, 6(2), pp. 208–216.

Huang, C.-L., Chen, Y. H. and Wan, T.-L. J. (2012) ‘The mahalanobis taguchi system—adaptive resonance theory neural network algorithm for dynamic product designs’, *Journal of Information and Optimization Sciences*, 33(6), pp. 623–635.

Jain, A. K. A. K., Duin, R. P. W. and Mao, J. (2000) ‘Statistical pattern recognition: a review’, *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 22(1), pp. 4–37.

Khalid, S., Khalil, T. and Nasreen, S. (2014) ‘A survey of feature selection and feature extraction techniques in machine learning’, *2014 Science and Information Conference*, pp. 372–378.

Li, C., Yuan, J. and Qi, Z. (2015) ‘Risky group decision-making method for distribution grid planning’, *International Journal of Emerging Electric Power Systems*, 16(6), pp. 591–602.

Lv, Y. and Gao, J. (2011) ‘Condition prediction of chemical complex systems based on Multifractal and Mahalanobis-Taguchi system’, in *ICQR2MSE 2011 - Proceedings of 2011 International Conference on Quality, Reliability, Risk, Maintenance, and Safety Engineering*, pp. 536–539.

der Maaten, L. J. P., Postma, E. O., den Herik, H. J., van der Maaten, L., Postma, E. O., van den Herik, J., der Maaten, L. J. P., Postma, E. O. and den Herik, H. J. (2009) ‘Dimensionality Reduction: A Comparative Review’, *Technical Report TiCC TR 2009-005*, 10(January), pp. 1–41.

Motwani, R. and Raghavan, P. (1996) ‘Randomized algorithms’, *ACM Computing Surveys*, 28(1), pp. 33–37.

Qinbao Song, Jingjie Ni and Guangtao Wang (2013) ‘A Fast Clustering-Based Feature Subset Selection Algorithm for High-Dimensional Data’, *IEEE Transactions on Knowledge and Data Engineering*, 25(1), pp. 1–14.

Rao, V. M. and Singh, Y. P. (2013) ‘Decision Tree Induction for Financial Fraud Detection’, in *Proceeding of the International Conference on Artificial Intelligence in Computer Science and ICT (AICS 2013)*, pp. 321–328.

Shi, Y. and Eberhart, R. (1998) ‘A modified particle swarm optimizer’, 1998 IEEE International Conference on Evolutionary Computation Proceedings. IEEE World Congress on Computational Intelligence (Cat. No.98TH8360), pp. 69–73.

Soylemezoglu, A., Jagannathan, S. and Saygin, C. (2011) ‘Mahalanobis-Taguchi system as a multi-sensor based decision making prognostics tool for centrifugal pump failures’, *IEEE Transactions on Reliability*, 60(4), pp. 864–878.

Theodoridis, S., Koutroumbas, K., Holmstrom, L. and Koistinen, P. (2009) *Pattern Recognition*, *Wiley Interdisciplinary Reviews Computational Statistics*.

Zaki, M. J., Wong, L., Berry, M. J. A., Linoff, G. S., Hegland, M., Zaki, M. J. and Wong, L. (2003) ‘Data Mining Techniques’, *WSPC/Lecture Notes Series: 9in x 6in*, 10(1–2), p. 545.

Appendix A Mathematical Proofs

Video provides a powerful way to help you prove your point. When you click Online Video, you can paste in the embed code for the video you want to add. You can also type a keyword to search online for the video that best fits your document. To make your document look professionally produced, Word provides header, footer, cover page, and text box designs that complement each other. For example, you can add a matching cover page, header, and sidebar.

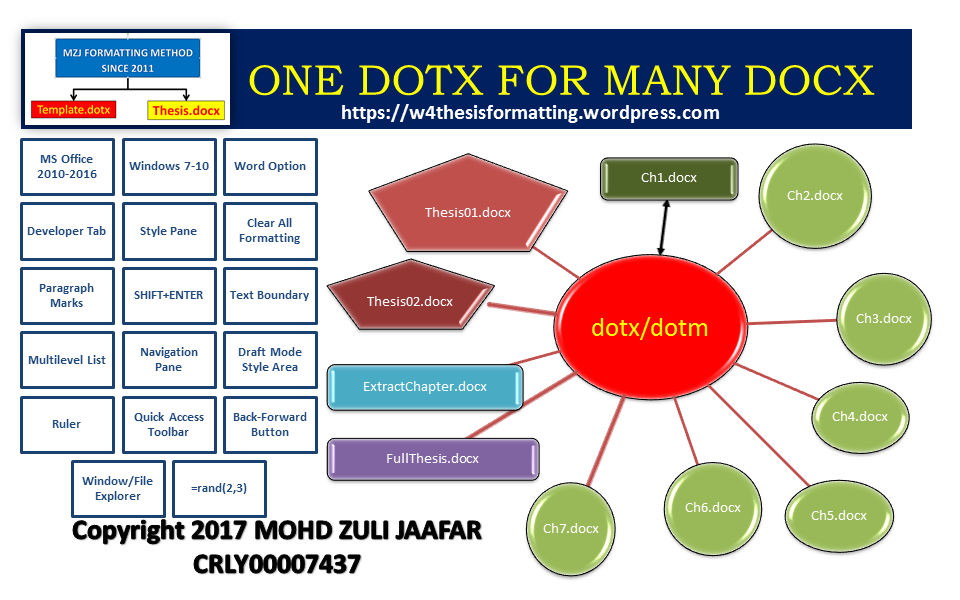


Figure A.1 xxxxxxxxxxxxxxxx

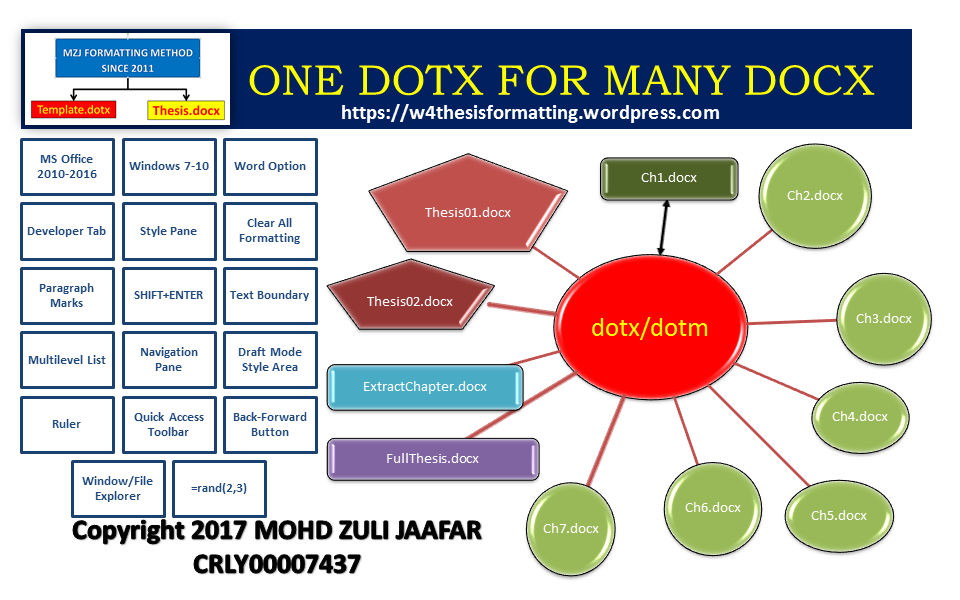


Figure A.2 xxxxxxxxxxxxxx

Table A. Example Repeated Header Table

| Title | Title | Title | Title |
| --- | --- | --- | --- |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

Appendix B Psuedo Code

Appendix C Time-series Results Long