

SYSTEM IDENTIFICATION AND INTELLIGENT CONTROL OF
AUTOMOTIVE AIR CONDITIONING SYSTEM.

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A project report submitted in partial fulfilment of the
requirements for the awards of the degree of
Master of Engineering (Mechanical Engineering)

Faculty of Mechanical Engineering
Universiti Teknologi Malaysia

SEPTEMBER 2015

To my beloved family

ACKNOWLEDGEMENT

In the name of Allah, Most Gracious and Most Merciful. Be upon His Messenger, Prophet Muhammad S.A.W and his companion. I am very thankful to Allah for his divine inspiration guidance and his blessing to me in completing this project report.

I would like to gratefully and express my appreciation to my supervisor, Assoc. Prof. Dr. Intan Zaurah Mat Darus for his guidance, understanding, patience, encouragement, ideas and advices through the whole process in completing my master project. Without him, this project might be quite impossible to be completed. Moreover, a lot of thank for all the lecturers that had helped me to complete this project.

Special thank goes to my beloved family, fiancée and friends for their support, encouragement, quiet patience and moral. 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.

ABSTRACT

The purpose of this study is to investigate the application of the variable speed compressor for an automotive air conditioning. A model structure selection based on system identification and intelligent control has been proposed in this study to enhance the automotive air conditioning. The previous experimental rig is using for data acquisitions input and output data from variable speed compressor voltage versus the temperature cabin for the common car model. Results were compared between the Least Square Method and Neural Network. It was discovered that neural network have the exploring potential solution in terms of real time, timing and predictive accuracy. Simulation results demonstrated the least square method result were accurate in this project but not purposely use due to off-line method. Since the AAC system operates under wide range of operation conditioning. It would be impractical to carry out system identification covering the entire operating range. Future work, the case studies towards the implementation of the proposed controller on a vehicle with exposure to actual environment disturbance.

ABSTRAK

Tujuan kajian ini adalah untuk menyiasat penggunaan pemampat kelajuan yang berubah-ubah dengan penyaman udara automotif. Pemilihan struktur model berdasarkan pengenalan sistem dan kawalan pintar telah dicadangkan dalam kajian ini untuk meningkatkan penyaman udara automotif. Pelantar eksperimen digunakan untuk pemerolehan data masuk dan keluar, voltan dari pembolehubah kelajuan pemampat diambil bergandingan dengan suhu kabin untuk model kereta penumpang. Keputusan dibandingkan antara *Least Square Method* dan *Neural Network* Ia telah ditemui bahawa *Neural Network* mempunyai penyelesaian berpotensi meneroka dari segi masa sebenar, masa dan ketepatan ramalan. Keputusan simulasi menunjukkan hasil *Least Square Method* adalah tepat dalam projek ini tetapi tidak boleh digunakan kerana menggunakan kaedah *off-line* iaitu data tidak boleh dikemaskinikan. Sejak sistem AAC yang beroperasi di bawah Pelbagai penyaman operasi. Ia akan menjadi tidak praktikal untuk melaksanakan pengenalan sistem yang meliputi pelbagai operasi keseluruhan. Projek masa hadapan, kes kajian terhadap pelaksanaan pengawal yang dicadangkan ke atas kenderaan dengan pendedahan kepada gangguan persekitaran yang sebenar.

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LIST OF ABBREVIATIONS

AAC	-	Automotive Air Conditioning
VSC	-	Variable Speed Compressor
SI	-	System Identification
ANN	-	Artificial Neural Network
DAQ	-	Data Acquisition
MSE	-	Mean Square Error.

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CHAPTER 1

INTRODUCTION

1.1 Research Background

The requirement on environmental regulations are stringent and has posed a great challenge to automotive industry to fulfill the demand for fuel saving and energy efficiency. Since, the air conditioning compressor is the single largest auxiliary load on automobile engine, the manufacturer are concerned with the cost effectiveness of automotive air conditioning (AAC) system design and their operating strategies. Enhancement for the AAC must be study to suit this problem. This project describes on system identification and intelligent method and control via variable speed compressor.

Conventional AAC system give leads to several drawbacks, such as poor temperature control, life time reduction of the component, limited operational condition and high energy consumption. Variable Speed Compressor (VSC) was introduced with proper speed control and continuous matching between the cooling capacity and the varying thermal load to overcome the issue. However, requirement to develop a predictive dynamic model behavior for control purposes in term of accuracy, highly transient and complexity requires tedious effort, expert knowledge, time and costs.

Objective for this study is to model of an automotive air conditioning system using conventional and intelligent method and control via variable speed compressor. Scope will cover literature review of automotive air conditioning system, variable speed compressor and intelligent algorithms. Input or output data acquisition of an automotive air conditioning system using experimental rig. Modelling of automotive air conditioning system using least square, recursive least square and neural network algorithm. Design development and simulation of self-tuning PID controller using

intelligent algorithm for automotive air conditioning system. Analyze, validate and verification of all of this develop controllers within MATLAB-simulink environment.

1.2 Problem Statement

- a) Conventional AAC system give leads to several drawbacks, such as poor temperature control, life time reduction of the component, limited operational condition and high energy consumption.
- b) Variable Speed Compressor (VSC) was introduced with proper speed control and continuous matching between the cooling capacity and the varying thermal load to overcome the issue. However, requirement to develop a predictive dynamic model behavior for control purposes in term of accuracy, highly transient and complexity requires tedious effort, expert knowledge, time and costs.

1.3 Research Scope

- a) Literature review of automotive air conditioning system, variable speed compressor and intelligent algorithms.
- b) Input or output data acquisition of an automotive air conditioning system using experimental rig.
- c) Modelling of automotive air conditioning system using least square, recursive least square and neural network algorithm.
- d) Design development and simulation of self-tuning PID controller using intelligent algorithm for automotive air conditioning system.
- e) Analyze, validate and verification of all of this develop controllers within MATLAB-Simulink environment.

1.4 Research Objective

To model of an automotive air conditioning system using conventional and intelligent method and control via variable speed compressor.

1.5 Theoretical Framework

Figure 1.1 at next page is showing the framework of this research. The critical steps will involve is checking the validation of the method.

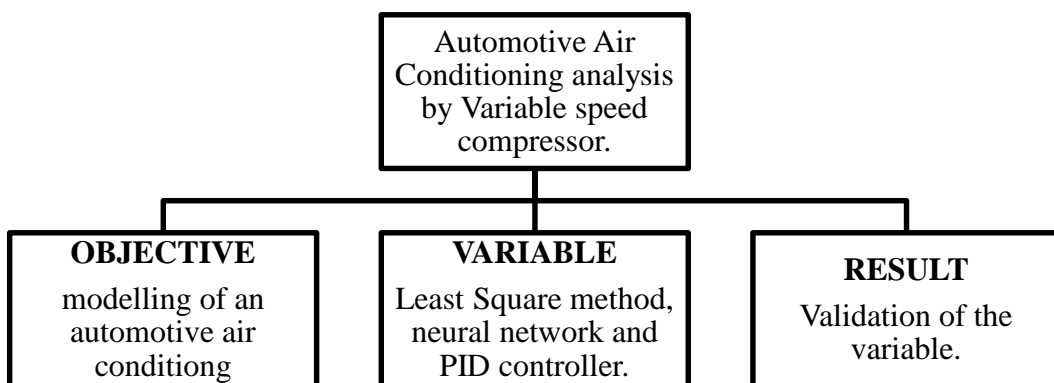


Figure 1.1 : Theoretical Framework

1.6 Research Outline

This report on "The System Identification And intelligent Control of Automotive Air Conditioning system is divided into 4 chapters.

Chapter 1 introduces the background study of this projects, the problem statement, project objectives, as well as the project scope and the summary of this project totally also known as the project outline.

Chapter 2 is a literature reviews and theory related gathered from electronic media, published journals, and books.

Chapter 3 the methodology will be development to achieve the objective of this thesis.

Chapter 4 for this chapter, simulation will be develop and the result will be obtained and discus.

Chapter 5 In this last chapter it is dedicated for conclusion of the study and recommendations on future improvements for different type of parameter and method.

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