

PROJEK SARJANA MUDA

DEVELOPMENT OF MANUAL TRANSMISSION POWERTRAIN
DYNAMIC MODEL FOR DRIVE
SIMULATOR.

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DEVELOPMENT OF MANUAL TRANSMISSION POWERTRAIN
DYNAMIC MODEL FOR DRIVE
SIMULATOR

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I declare that this report is my own work except for any summary or quotation from every single source is explained.

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Date : 7 APRIL 2010

For my beloved father, mother and family

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ABSTRACT

The purpose of this project is to build a manual transmission powertrain dynamics model to be used in drive simulator simulation and validation. With the estimation of parameters that will be given to the model, the drive simulator will look like such as the real driving situation. This project will be used the Simulink software to build the manual transmission powertrain dynamics model. The powertrain in manual transmission vehicle for rear wheel drive (RWD) consist of engine, clutch, transmission or gearbox, propeller shaft, differential gear, drive shaft and wheel. So the result of this project will be the torque and speed at each powertrain component. For give more efficient to the project result, the experiment also will be provided to compare between experimental and project result. With the experimental result the design of manual transmission powertrain dynamic model will be fixed and the final results of this project do not have a lot difference compare to real situation. With the possible result, the design of manual transmission powertrain dynamic model finally will be used for drive simulator.

ABSTRAK

Tujuan projek ini adalah untuk membina atau mereka sebuah model dinamik penghantaran kuasa bagi transmisi manual yang akan digunakan dalam simulasi pemanduan. Dengan memberikan anggaran parameter-parameter kepada model, simulasi pemanduan akan kelihatan seperti pemanduan sebenar. Projek ini akan menggunakan perisian Simulink untuk membina model dinamik penghantaran kuasa bagi kotak gear manual. Penghantaran kuasa bagi kotak gear manual bagi pemanduan tayar belakang (RWD) adalah merangkumi enjin, klac, kotak gear atau transmisi, `propeller shaft` , `differential gear`, `drive shaft` dan tayar. Jadi keputusan untuk projek ini adalah merangkumi kuasa, tork dan kelajuan bagi setiap komponen penghantaran kuasa. Untuk memberikan keputusan projek yang lebih efisien, eksperimen juga akan dijalankan dan keputusan antara projek dan eksperimen akan dibandingkan. Dengan berpandukan keputusan daripada eksperimen, model dinamik penghantaran kuasa bagi transmisi manual akan dibaiki atau diubah supaya keputusan terakhir projek ini tidak mempunyai perbezaan yang ketara dengan pemanduan yang sebenar. Dengan keputusan atau hasil yang munasabah, rekaan model dinamik penghantaran kuasa bagi transmisi manual akhirnya dapat digunakan untuk simulasi pemanduan.

CONTENT

CHAPTER	SUBJECT	PAGE
	DECLARATION	ii
	ACKNOWLEDGEMENT	iv
	ABSTRACT	v
	<i>ABSTRAK</i>	vi
	CONTENT	vii
	LIST OF TABLE	xii
	LIST OF FIGURE	xiii
	LIST OF SYMBOL	xvi
	LIST OF APPENDIX	xviii
 CHAPTER I	 INTRODUCTION	
	1.1 Project Introduction	1
	1.2 Project Objective	3
	1.3 Problem Statement	3
	1.4 Scope	3
 CHAPTER II	 LITERATURE REVIEW	
	2.1 Engine	4
	2.1.1 Gasoline Engine Configurations	5
	2.1.1.1 V Type Engine	5
	2.1.1.2 In-line Engine	6
	2.1.1.3 Flat (horizontal-opposed) Engine	6

CHAPTER	SUBJECT	PAGE
	2.1.1.4 Rotary Engine	7
	2.1.2 Internal Combustion	8
	2.1.3 Basic Engine Parts	9
	2.1.3.1 Spark Plug	9
	2.1.3.2 Valves	9
	2.1.3.3 Piston	9
	2.1.3.4 Piston Rings	9
	2.1.3.5 Connecting Rod	10
	2.1.3.6 Crankshaft	10
	2.1.3.7 Sump	10
2.2	Clutch	10
	2.2.1 Introduction	10
	2.2.2 Clutch Slip	12
2.3	Transmission	12
	2.3.1 Introduction	12
	2.3.2 Manual Transmission	14
	2.3.2 Simple Transmission	15
	2.3.4 First Gear	17
	2.3.5 Real Gear	18
	2.3.6 Reverse Gear	20
	2.3.7 Synchronizers	20
2.4	Differential	21
2.5	Driveshaft	24
	2.5.1 Front Engine Rear Wheel Drive	24
	2.5.2 Front Engine Front Wheel Drive	25
	2.5.3 Four Wheel Drive And All Wheel Drive	25
2.6	Wheel	26
2.7	Longitudinal Vehicle Dynamics	26
	2.7.1 Aerodynamic Drag Force	28

CHAPTER	SUBJECT	PAGE
	2.7.2 Longitudinal Tire Force	29
	2.7.2.1 Slip Ratio	29
	2.7.3 Rolling Resistance	30
	2.7.3.1 Calculation of Normal Tire Force	31
2.8	Driveline Dynamics Equations	32
	2.8.1 Engine	32
	2.8.2 Gearbox	35
	2.8.3 Differential Gear	36
	2.8.4 Wheel	37
CHAPTER III	METHODOLOGY	
3.1	Literature Review	40
3.2	Problem Statement	40
3.3	Simulation Design	40
3.4	Experiment	40
3.5	Result And Data Analysis	41
3.6	Discussion	41
CHAPTER IV	SIMULATION DESIGN	
4.1	Engine Subsystem Design	43
	4.1.1 Lookup Table	44
	4.1.2 Throttle Pedal	47
	4.1.3 Constant Block	48
	4.1.4 Gain Block And Divide Block	49
	4.1.5 Integrator Block	50
	4.1.6 Subsystem Block	52
4.2	Manual Transmission Or Gearbox Subsystem Design	54

CHAPTER	SUBJECT	PAGE
	4.2.1 Multiport Switch Block	58
	4.2.2 Neutral Gear Using Switch Block	58
	4.2.3 Manual Transmission Subsystem	60
4.3	Differential Gear Subsystem Design	61
4.4	Longitudinal Vehicle Dynamics Subsystem Design	63
	4.4.1 Aerodynamic Drag Subsystem Design	64
	4.4.2 Longitudinal Tire Forces Subsystem Design	66
	4.4.3 Rolling Resistance	68
	4.4.4 Complete Longitudinal Forces Subsystem	70
4.5	Clutch Subsystem Design	72
4.6	Complete Simulation	73
4.7	Data And Parameters	74
 CHAPTER V	 EXPERIMENT AND VALIDATION	
5.1	Tractive Force Vs Vehicle Speed	77
5.2	Engine Torque Vs Engine Speed	78
5.3	Engine Speed Vs Vehicle Speed	79
 CHAPTER VI	 RESULT	
6.1	Tractive Force Vs Vehicle Speed Simulation Graph Result	81
6.2	Engine Speed Vs Vehicle Speed Simulation Graph Result	82
6.3	Engine Torque Vs Engine Speed Simulation Graph	83
 CHAPTER VII	 DISCUSSION	
7.1	Result 1	84
7.2	Result 2	85

CHAPTER	SUBJECT	PAGE
	7.3 Result 3	85
CHAPTER VIII	CONCLUSION AND SUGGESTION	
	8.1 Conclusion	86
	8.2 Recommendation	87
	REFERENCE	88
	BIBLIOGRAPHY	89
	APPENDIX	90

LIST OF TABLE

TABLE	TITLE	PAGE
4.1	Gear Ratio For Each Gear	54
4.2	Simulation Parameters	74

LIST OF FIGURE

FIGURE	TITLE	PAGE
1.1	Rear Wheel Drive (RWD) Manual Transmission Powertrain	2
2.1	V Type Engine	5
2.2	In-line Engine	6
2.3	Flat (horizontal-opposed) Engine	6
2.4	Rotary Engine	7
2.5	Clutch Plate	11
2.6	Pressure Plate	11
2.7	Manual Transmission Location In The Powertrain (RWD)	14
2.8	Example of Manual Transmission Gear Ratio	15
2.9	Simple Two Speed Gear In Neutral	16
2.10	Gear Shift	17
2.11	Five Speed Manual Transmission	19
2.12	Gear Changing	19
2.13	Reverse Gear	20
2.14	Gear Synchronize	21
2.15	Front Wheel Drive Car	22
2.16	Rear Wheel Drive Car	23
2.17	All Wheel Drive Car	23
2.18	Vehicle Longitudinal Forces	27
2.19	Normal Tire Forces	31
3.1	Methodology Flow Chart	39
4.1	Engine Input And Output	43

4.2	Lookup Table Block	44
4.3	Lookup Table Function Block Parameters	44
4.4	Table From Lookup Table	45
4.5	3D Graph From Lookup Table	45
4.6	Parameter of Engine Design From Lookup Table Table	46
4.7	Engine Design 3D Graph From Lookup Table	46
4.8	Blocks of Engine Simulation Design	47
4.9	Slider Gain Block And Dialog Box	48
4.10	Constant Block And Dialog Box	48
4.11	Gain Block And Dialog Box	49
4.12	Divide Block And Dialog Box	50
4.13	Integrator Block And Dialog Box	51
4.14	Scope Block	51
4.15	Subsystem Block	52
4.16	Final Simulation Design of Gasoline Engine	53
4.17	Gearbox Input And Output	54
4.18	Multiport Switch Block And Dialog Box	56
4.19	Multiport Switch Block Connection	57
4.20	Manual Switch Block	57
4.21	Switch Block And Dialog Box	59
4.22	Neutral Gear Design Simulation	59
4.23	Complete Simulation Design of Manual Transmission	60
4.24	Manual Transmission Subsystem	60
4.25	Input And Output of Differential Gear	61
4.26	Differential simulation Design And Subsystem	63
4.27	Blocks Simulation Design For Aerodynamic Drag	65
4.28	Aerodynamic Drag Subsystem	66
4.29	Design Simulation of Longitudinal Slip Ratio With The Subsystem	67
4.30	Rolling Resistance Force Subsystem	69
4.31	Design Simulation of Vertical Loads	70

4.32	Complete Simulation of Longitudinal Vehicle Dynamics	71
4.33	Clutch Assumption	72
4.34	Clutch Simulation Blocks Design	72
4.35	Clutch Subsystem	73
4.36	Final Simulation Design of Manual Transmission Dynamics	74
5.1	Tractive Force Vs Speed Graph	77
5.2	Engine Torque Vs Engine Speed	78
5.3	Engine Speed Vs Vehicle Speed	79
6.1	Simulation Graph Result 1	81
6.2	Simulation Graph Result 2	82
6.3	Simulation Graph Result 3	83

LIST OF SYMBOL

P_e	= Engine power (Watt)
P_m	= Maximum power of engine (Watt)
W_m	= Engine speed at Maximum power (Rad/sec)
W_e	= Engine speed (Rad/sec)
P_w	= Power at wheel (Watt)
η overall	= Overall efficiency
η_c	= Clutch efficiency
η_g	= Gearbox efficiency
η_d	= Differential gear efficiency
N_g	= Gearbox ratio
N_d	= Differential gear ratio
T_w	= Wheel torque (N.m)
T_p	= Propeller torque (N.m)
T_e	= Engine torque (N.m)
T_p	= Propeller torque (N.m)
F_x	= Traction force (N)
W_w	= Wheel speed (rad/sec)
V_x	= Velocity in x direction (m/s)
R_w	= Wheel radius (m)
T_{in}	= Input (engine torque)
ρ	= Mass density of air (kg/m ³)
C_d	= Aerodynamic drag coefficient
A_F	= Frontal area of vehicle (m ²)

V_x	= Longitudinal vehicle velocity (m/s)
V_{wind}	= Wind velocity (m/s)
F_{xf}	= The longitudinal tire force at the front tires (N)
F_{xr}	= The longitudinal tire force at the rear tires (N)
F_{aero}	= The equivalent longitudinal aerodynamic drag force (N)
R_{xf}	= The force due to rolling resistance at the front tires (N)
R_{xr}	= The force due to rolling resistance at the rear tires (N)
m	= The mass of the vehicle (kg)
g	= The acceleration due to gravity (m/s ²)
θ	= The angle of inclination of the road on which the vehicle is traveling (degree)
$C_{\sigma f}$ and $C_{\sigma r}$	= Longitudinal tire stiffness (N)
σ_x	= Slip ratio.
f	= Rolling resistance coefficient
F_{zf}	= Front wheel vertical load (N)
F_{zr}	= Rear wheel vertical load (N)

LIST OF APPENDIX

FIGURE	TITLE	PAGE
A	Coefficient of Rolling Resistance	90
B	Aerodynamic Resistance Coefficient	91
C	Values of Aerodynamic Resistance Coefficient For Various Type of Vehicle	91
D	Proton Waja 1.6 Specification	92

CHAPTER I

INTRODUCTION

1.1 Project Introduction

A manual transmission power train consists of engine and driveline. The main parts of the driveline are clutch, transmission, shafts and wheels. The driveline is a fundamental part of a vehicle and its dynamics has been modeled in different ways depending on the purpose. In order to analyze and develop of manual transmission power train dynamic (forces generated and the responses of the power train), a model should be developed. From the manual transmission power train dynamic model, a mathematical model will be developed. Then, with the development of power train mathematical model, a simulation can be developed using software like Mat Lab and Simulink. Finally the simulation will be using for the drive simulator.

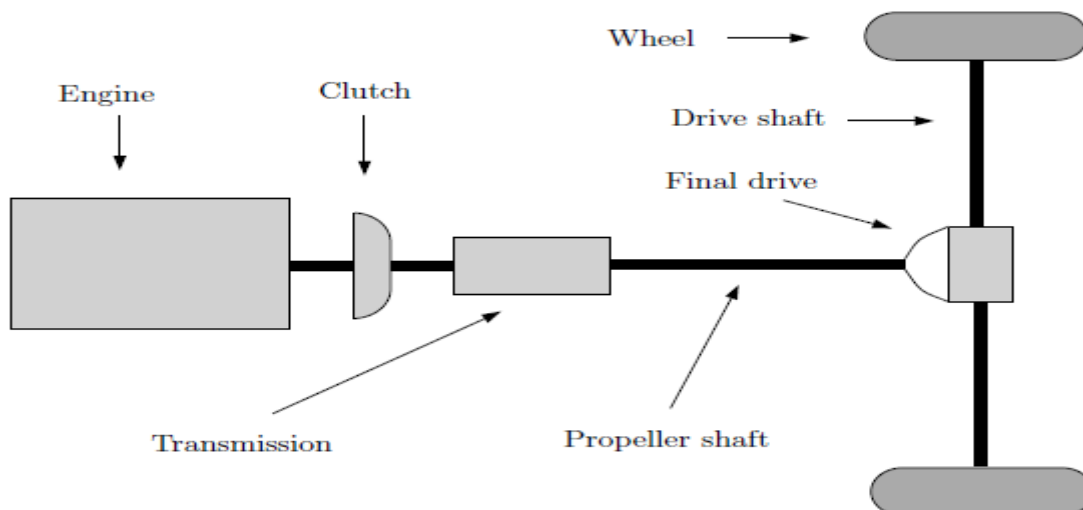


Figure 1.1: Rear Wheel Drive (RWD) Manual Transmission Powertrain

Simulation has become common practice in automotive developments because it speeds up the development cycle and decreases costs. The increasing demand for driving comfort has put some emphasis on the dynamics of the power train. In this context dynamic simulations can be of aid in several aspects:

- Possible sources of unwanted behaviour of the system can be detected in early stages of the design process. This allows the designer to correct the design at an early stage and minimizes the need for expensive prototypes. It also makes the design process faster.
- Known problems can be analyzed and possible solutions can be tested in the simulation models. This leads to better solutions, faster treatment and minimizes the need for testing.
- Dynamic simulations lead to a better understanding of the behaviour of the system. This knowledge can then be used in future designs to avoid possible problems.

However the main point of this project is to develop the manual transmission powertrain dynamics model for drive simulation and not a prototype or design. So this project only covers about the identification of the powertrain, development of the powertrain dynamics model and the parameter estimation.

1.2 Project Objective

To built a manual transmission powertrain dynamics model to be used in drive simulator simulation and validation.

1.3 Problem Statement

To give the passions to the one who are driving the drive simulator, the simulation must be look like the real one. In order to give the perfect simulation, the drive simulator of manual transmission powertrain dynamics model is designed. With the dynamics identification and parameter estimation given to the model, the result must be very interesting.

1.4 Scope

- Powertrain dynamics identification.
- Develop powertrain dynamics model.
- Parameters estimation.

CHAPTER II

LITERATURE REVIEW

In a vehicle, the term powertrain refers to the group of components that generate power and deliver it to the road surface. This includes the engine, transmission, driveshafts, differentials, and the final drive.

2.1 Engine

An engine is a mechanical device that produces some form of output from a given input. The purpose of an engine is to produce mechanical power from a fuel source. Originally an engine was a mechanical device that converted force into motion. The purpose of a gasoline car engine is to convert gasoline into motion so that your car can move. Currently the easiest way to create motion from gasoline is to burn the gasoline inside an engine. Therefore, a car engine is an internal combustion engine (combustion takes place internally).

The core of the engine is the cylinder, with the piston moving up and down inside the cylinder. Most cars have more than one cylinder (four, six and eight cylinders are common). In a multi-cylinder engine, the cylinders usually are arranged in one of three ways. That are inline, V or flat (also known as horizontally opposed or boxer), as shown in the following figures.