'Kami akui bahawa telah membaca

karya ini dan pada pandangan kami karya ini

adalah memadai dari segi skop dan kualiti untuk tujuan penganugerahan

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DEVELOPMENT OF A SIMPLE CVT SYSTEM

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Memenuhi sebahagian daripada syarat penganugerahan

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ABSTRACT

This thesis details the work undertaken in a project to develop a simple continuously variable transmission (CVT) mechanism and to control the gear ratio of the CVT system. The aims of the project are develop a simple CVT mechanism. experiments identifications of the system's behavior and ratio control of the CVT system. The work entailed the development of a CVT transmission prototype capable of sliding the moveable half pulley by using the linear actuator motor. The CVT prototype developed is capable of testing the transmission at the controlled driver and driven linear actuator motor. The experimental work will carry out on the CVT prototype to validate the MAT-LAB simulation results of CVT ratio control behavior. The thesis will introduces a simple developed CVT control system and electronically controlled linear actuator motor to change the gear ratio. The axial clamping forces are based on the linear actuator to determine the distance of sliding in axial direction for moveable primary and secondary pulleys. The function of primary pulley is to determine the gear ratio while the secondary pulley is functioned as belt tensional to avoid slippage. Finally, some proposals are made to develop the CVT prototype that based on the electrically controlled CVT as compared to inefficient mechanical controlled CVT.

ABSTRAK

Ini adalah tesis terperinci dimana kerja yang dilaksanakan dalam projeck pengembangan yang sederhana terus transmisi variabel (CVT) dan mekanisme untuk mengawal gigi rasio daripada sistem CVT. Tujuan daripada projeck ini adalah untuk mengembangkan mekanisme CVT yang sederhana, ujikaji penentuan daripada sistem kawalan perilaku dan rasio daripada sistem CVT. Kerja perlu dilakukan untuk pengembangan transmisi prototipe CVT yang mampu bergerak geser pada pulley dengan menggunakan linear aktuator motor. Prototipe yang dikembangkan adalah mampu untuk pengujian pengiriman pada kelajuan motor yang dikawal dan daya aksial clamping berdasarkan masukan kecepatan. Kerja ujikaji akan dilakukan pada CVT prototipe untuk memvalidasi MAT-LAB hasil simulasi CVT modeling. Tesis ini turut memperkenalkan CVT untuk sistem kawalan kecepatan dan masukan baik daya aksial clamping pada pulleys. Daya aksial clamping yang didasarkan pada kecepatan masukan untuk menentukan jarak luncur di arah aksial untuk bergerak pulleys dasar dan menengah. Fungsi utama adalah untuk menentukan belok gear rasio sedangkan sekunder pulley adalah berfungsi sebagai menegangkan tali untuk menghindari licin. Akhirnya, proposal yang dibuat untuk mengembangkan CVT prototipe yang berdasarkan elektrik adalah lebih dikawal berbanding dengan CVT mekanikal yang tidak efisien dikawal.

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CVT	=	continuously variable transmission
SFC	=	specific fuel consumption
WOT	=	wide open throttle
BSFC	=	brake specific fuel consumption
E-CVT	=	electronically continuously variable transmission
CAD	=	computer aided design
3D	=	three dimensions
DC	=	direct current
AC	=	alternate current
R	=	Resistor value
V	=	Voltage

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CHAPTER 1

INTRODUCTION

Over the last decade, the environmental pressures of the modern world have dictated the work of the automotive engineer. Government bodies were under pressure from the environmental lobby and have had to increase the severity of the constraints imposed upon motor vehicles, which in terms of both emission and fuel consumption. Recently, legislation controlling vehicle emissions has increase, and at the same time governments throughout the world have increase the vehicle and fuel taxes in an attempt both to move the population onto forms of public transport and reduce the average engine size in vehicles. As the pressures of these constraints has increased, engineer have concentrated on the transmission of the vehicle and in particular improving its efficiency.

The efficiency of any vehicle transmission system is an important factor in the overall efficiency of the vehicle. With the increased environmental requirements described above it is important to understand where the inefficiencies lie within a transmission design. Continuously variable transmissions (CVT) have been on the market for a number of years now, and should in principle offer increased fuel efficiency over similarly sized of fixed ratio transmissions. By having effectively an infinite number of gear ratios the CVT should allow better matching of the engine operating conditions to the variable driving conditions experience. For example, Figure 1-1 below shows how a typical commercial vehicle combustion engine's power and torque against engine speed graph, the engine can be constrained to operate as near as possible to its maximum efficiency point.

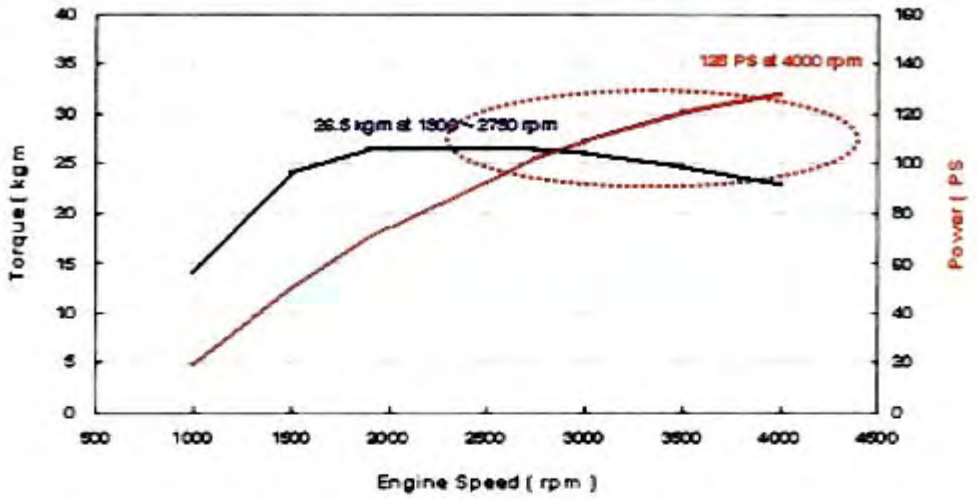

Figure 1-1: Graph of power and torque against engine speed

It can be seen that this CVT strategy aims for the engine to operate as near to the maximum power and torque curve region as possible (red dotted circle region in fig 1-1). From figure 1-1, the vertical axis on the left represent the torque and the right vertical axis represents the power. The horizontal axis of the graph represents the operating engine speed in terms of revolution per minute. It can also be seen that for a large range of intermediate engine speeds the transmission is able to maintain the engine in their maximum power and torque curve regions. By operating in this region the vehicle fuel consumption should be reduced. In reality few CVT controllers are optimized purely for power and torque curve, other considerations in controller strategy might include vehicle emissions and vehicle drivability. In these cases a weighted ideal engine operating line is generated, based upon the perceived of each output to the overall vehicle performance.

Despite these theoretical predictions to date increased power and torque have not been realized by production vehicles fitted with CVT. Rather the car manufacturer fitted higher displacement engine to increase the performance of the vehicle. Beside that, performance figures compared to equivalent fixed ratio vehicles have been at best equal and in most cases considerably lower. Since the control strategy for increased overall vehicle performance is well founded, it must be concluded that current CVT systems have a lower efficiency than their fixed ratio counterparts. This inefficiency has been linked to a number of possible inherent