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Study of The Auto Transmission Dynamics System and The Effects of Clutch Pressure on Planetary Gear to Optimized the Output Speed

Khai Chu Thanh[1*]

Dong Nai Technology University, Bien Hoa, Viet Nam

Email address :

chuthanhkhai@dntu.edu.vn

[*]Corresponding author

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Abstract: The performance of an automatic transmission is dependent on the dynamics of its components, such as the clutch, planetary gear, and torque converter. In particular, the clutch pressure and planetary gear output speed can affect the overall performance of an automatic transmission. In this paper, It will present the kinematic relations, the dynamics of planetary structure, calculating the impact of braking torque of brake and clutch to slip to the speed of the vehicle Toyota Camry used automatic transmission A140L. Since then, the graph describing the dependence of the transmission ratio gearbox in the hands of, the speed of vehicles on the oil pressure brake and clutch. Finally, modeling and simulation control of such operations by SolidWorks and Matlab Simulink Simmechanics software to clear about this effect.

Keywords: Automotive Engineering Technology, Hydraulic System, Dynamics, Planetary Structure, Transmission Ratio

1. Introduction

During operation, for some reason, when an oil pressure failure occurs, the oil pressure will no longer be large enough as desired, the braking torque of the central elements will decrease and produce a slip between the steel discs and the steel discs. friction disc of the brake and clutch, causing the output speed of the gearbox as well as the vehicle speed to be reduced [1-4]. To see this effect clearly, we first calculate in theory and then build a control model and simulate the operation of the gearbox when the frictional torque of the brake and clutch is reduced. The simulation results show that when the hydraulic oil pressure is reduced, the frictional torque is reduced and the vehicle speed will also decrease [3-5].

The performance of an automatic transmission is heavily dependent on the clutch pressure applied to the planetary gear set. The pressure exerted by the clutch on the planetary gear set determines the gear ratio, and the gear ratio has a direct effect on the output speed of the transmission. Research has been conducted to study the dynamics of the automatic transmission system and the effect of clutch pressure on the planetary gear set output speed [6-7].

The effect of clutch pressure on the planetary gear system was studied by changing the pressure of the clutch on the planetary gear set and measuring the output speed of the transmission. The results of the study showed that the output speed of the transmission increased as the clutch pressure increased. The study also showed that the output speed decreased as the clutch pressure decreased [8-9].

The effect of the clutch pressure on the output speed of the transmission was studied using a computer simulation model. The simulation model was used to study the relationship between the clutch pressure, the gear ratio, and the output speed of the transmission. The results of the study showed that the output speed of the transmission increased as the clutch pressure increased, and decreased as the clutch pressure decreased [10-13].

2. Method

This research project would involve studying the dynamics of different types of automatic transmissions, specifically focusing on the effects of clutch pressure on the planetary gear output speed. The research would involve comparing different types of automatic transmissions, such as dual-clutch, continuously variable transmission (CVT), and traditional torque converter transmissions [12-14].

The research would involve analyzing the effects of clutch pressure on the output speed of the planetary gear set. This would involve factors such as the gear ratio, the force applied to the clutch, and the engine speed. The study would also look at the effect of clutch pressure on the overall transmission efficiency and power output [11].

In addition, the research would also look at how different types of automatic transmissions are affected by clutch pressure. This would involve studying how various components of the transmission respond to changes in clutch pressure, such as the torque converter, the planetary gear set, the clutch plate, and the transmission fluid. The research would also analyze how the transmission's clutch pressure affects its overall performance, such as its shift quality, fuel economy, and acceleration.

Finally, the research would also analyze the effects of clutch pressure on the overall durability of the transmission.

Research and calculate the effect of braking torque of brakes and clutches in automatic transmission on vehicle speed when operating, we must first find the kinematics and dynamics relationship of a general mechanism, from which it is deduced that the braking torque force required to harden a central element of the planetary gear transmission corresponds to the oil pressure generated by the hydraulic system when in good operation. From that theoretical basis, we apply to the Toyota A140L automatic transmission specifically used on the Toyota Camry 3S-FE engine, with two Wilson-style planetary transmissions mounted in series in the gearbox [15].

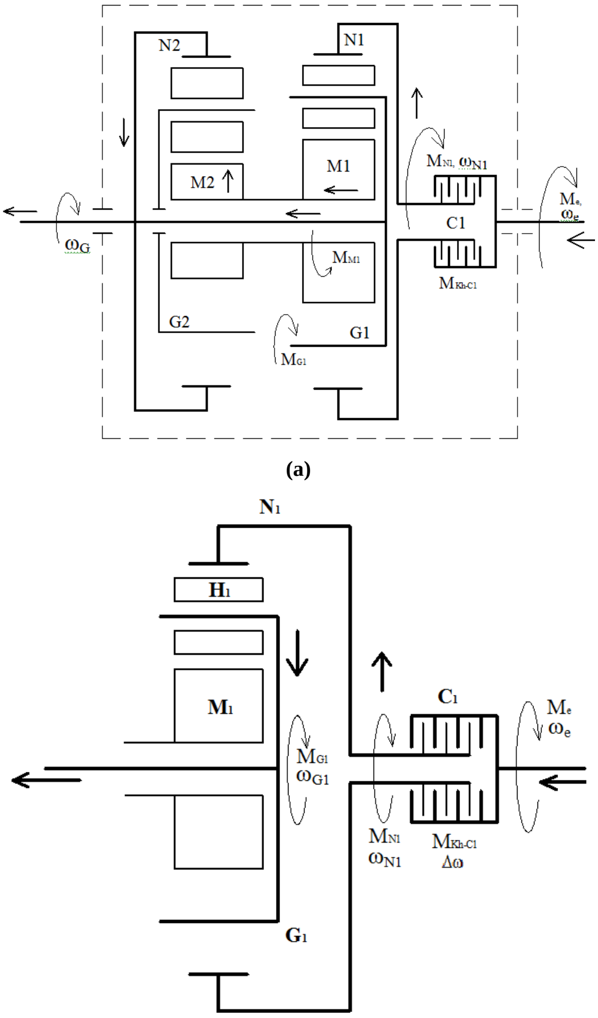
Finally, build a control model and simulate that activity using SolidWorks and Matlab Simulink Simmechanics to learn about this effect. From there, draw a graph describing the dependence of the transmission, the vehicle speed on the oil pressure of the brake and the clutch [14 - 15].

Research on auto transmission dynamics can involve several topics, such as the design of transmission systems, the optimization of transmission components, the development of new transmission technologies, and the assessment of the interaction between the transmission system and the vehicle. It can also involve the analysis of the various types of transmission systems, including manual, automated, and hybrid transmissions. Additionally, research on auto transmission dynamics can include the investigation of the effects of various environmental conditions on the performance of transmission systems.

The communicator works as follows:

- Active element: N1 front ring gear is driven by C1 clutch
- Passive element: The lead rod G1 is connected to the rear ring gear N2.

When the oil pressure decreases and will generate slippage between the steel discs and the friction disc in the C1 clutch mechanism, we get the operating principal diagram shown in Figure 1.



(a)

(b)

Figure 1: *(a) Operation diagram. (b) When clutch C1 slips.*

When clutch C1 slips, the speed will be reduced according to the clutch force:

$$\omega_{N1} = \frac{\omega_e.\mu.F_{C1}.R_{tb}.z_{ms}}{M_e} \text{ (rad/s)}$$

Based on the technical parameters of the vehicle and the input data of the Toyota 3S-FE, we build a control model and a 3D block diagram (Figure 2) on Matlab Simulink Simmechanics software.

The control model is implemented by a Simulink and Simmechanics Toolbox. The 3D block diagram allows us to analyze the system in more detail and to identify the various components and their interactions. The 3D block diagram includes the following elements:

• Engine: This block represents the engine itself and all the components that are part of it. This includes the combustion chamber, fuel injectors, spark plugs, and other engine-related components.

• Intake and Exhaust System: This block includes the intake and exhaust system components such as the air filter, intake manifold, exhaust manifold, catalytic converter, and muffler.

• Ignition System: This block represents the components of the ignition system such as the spark plugs, coils, and distributor.

• Fuel System: This block includes the components of the fuel system such as the fuel pump, fuel injectors, and fuel pressure regulator.

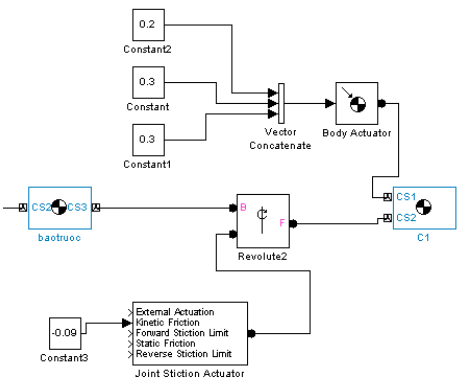
• Cooling System: This block includes the components of the cooling system such as the radiator, thermostat, and water pump.

• Control System: This block represents the components of the control system such as the ECU, sensors, and actuators.

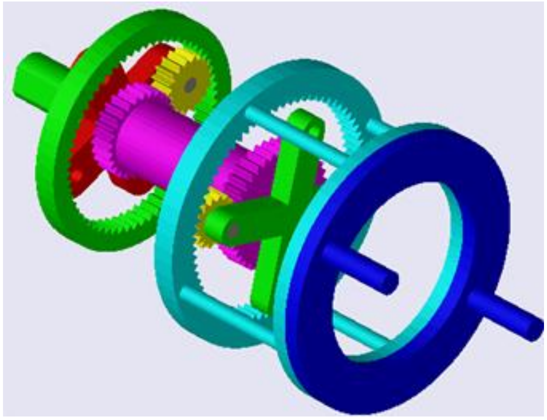
• Transmission System: This block includes the components of the transmission system such as the clutch, gearbox, and differential.

• Vehicle Dynamics: This block includes the components of the vehicle dynamics such as the suspension, wheels, and tires.

All of these components are connected through the various pipelines and circuits to form the complete system. The control model can then be used to simulate the system and analyze its behavior



(a)



(b)

Figure 2: *(a) Diagram of frictional force control C1. (b) 3D block diagram* in Simulink Simmechanics

Frictional force control C1 is a type of control system that uses friction to control a system. It uses a combination of friction and a motor to apply a force to an object or system to achieve a desired outcome. The system consists of a motor, a friction wheel, a controller, and a friction surface. The motor is used to rotate the friction wheel, which applies a force to the friction surface. This force is then controlled by the controller, which regulates the amount of force applied. The friction wheel is typically made of a material such as rubber, which provides a low-friction surface for the wheel to slide against the friction surface. The controller is used to regulate the amount of force applied, allowing for precise control over the system.

Simmechanics is a 3D multibody simulation toolbox for Simulink. It enables you to create models of rotating and translational mechanical systems, including parts such as frames, joints, sensors, actuators, and other components. You can create 3D block diagrams that represent the physical structure of your system and connect them to the Simulink blocks that define the behavior of the system. You can then simulate the system in 3D to explore its behavior and performance.

3. Result

After running the software, we see that the output speed of the passive shaft is the front lever and the rear ring gear depends on the friction force of the clutch C1. The results showing that dependence are shown in Figures 3 and 4:

The figures show that the output speed of the passive shaft increases with the front lever and the rear ring gear. As the friction force of the clutch C1 increases, the output speed of the passive shaft increases as well. The figures indicate that the output speed of the passive shaft is highly dependent on the friction force of the clutch C1.

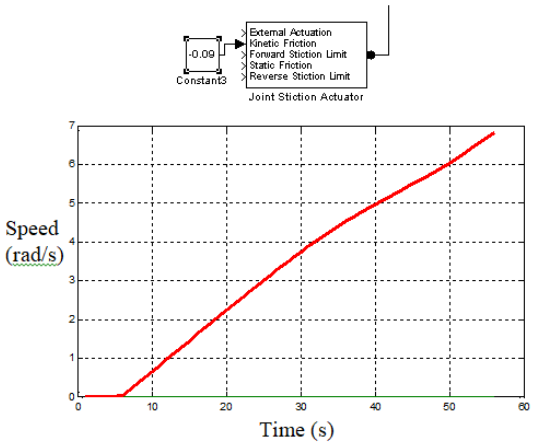


Figure 3: *The speed achieved when the friction value is 0.09*

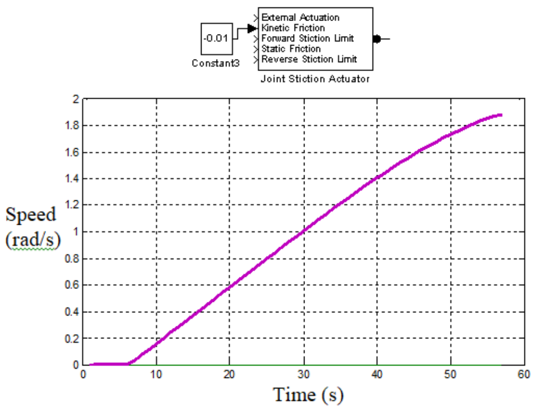


Figure 4: *The speed achieved when the friction value is 0.01*

The figures also show that the output speed of the passive shaft is greater when the front lever and the rear ring gear are in the same direction than when they are in opposite directions. This indicates that the passive shaft is more efficient when the front lever and rear ring gear are in the same direction. Overall, these figures demonstrate that the output speed of the passive shaft is highly dependent on the friction force of the clutch C1, and that it is more efficient when the front lever and rear ring gear are in the same directio

4. Conclusion

To solve this problem, engineers need to assess the kinematics and dynamics of the gear train. They should identify the components responsible for the reduction of vehicle speed and examine the torque and power changes in the system. They should also consider the impact of the environment on the gear train and its components.

By analyzing the system, engineers can then determine the root cause of the problem and identify the best solution. This could involve replacing the faulty hydraulic systems, solenoid valves, or oil lines. It could also involve optimizing the design of the gear train and its components to increase the frictional torque and power. With the case studies and simulation results about the kinematics and dynamics of the gear train in the automatic transmission, we see that when the vehicle is operating normally, a system problem occurs. When hydraulics, solenoid valves or oil lines cause the force to press the oil to the clutches and brakes, the frictional torque to brake the central elements of the planetary transmission is also reduced, resulting in a lower speed. Vehicle speed is reduced compared to normal time.

Finally, engineers should use simulations to test the effects of any changes made to the system. This will help them to determine whether their proposed solution is effective and will prevent the issue from occurring again in the future.

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