Automatic monitoring method for the rotation efficiency of the transmission of heavy duty vehicle

Xiaofen Fang
Quzhou College of Technology, Institute of Mechanical and Electronic Engineering, Quzhou, China

Email: fangxiaofen1985@hotmail.com

Abstract. When the conventional logistics distribution demand forecasting method was used to forecast the multi-region logistics distribution demand, there was a lack of low analysis accuracy. Therefore, a multi-region logistics distribution demand forecasting method based on big data analysis was proposed. Big data technology was introduced to build a multi-region logistics distribution demand forecasting framework and to build a multi-region logistics distribution model. Based on the determination of different demands of logistics distribution among regions, the model of demand forecasting was embedded to realize the prediction and analysis of multi-region logistics distribution demand. The experimental data showed that the big data prediction method proposed was 57.23% higher in accuracy than the conventional method, which was suitable for the prediction of logistics distribution demand in different regions and multiple regions.

1. Introduction
The variation range of engine speed and torque used by modern cars is limited, but the driving conditions of cars vary greatly, which makes the requirements of driving force and speed change in a large range. For example, a car does not need a high speed at the start, but it needs a large driving force. While driving on the highway, the driving force does not need to be too large, but it needs a high speed. This demand characteristic of the automobile is contradictory to the speed of the engine -- torque characteristic, and the transmission can solve this contradiction[1]. When synchronization lock ring cone and stay within the joint after contact with the cone outer circle of the gear under the action of friction torque, speed and the synchronous gear ring lock ring equal speed quickly, both synchronous rotation, the lock ring ring relative to the synchronous speed is zero, thus inertia moment also disappear at the same time, when the driver on axial force of the joint sets, joint sets and synchronization lock ring gear ring joint, and further to stay joint gear tooth ring joint and complete the shift process[2].

2. Construction of Automatic Monitoring Model of Heavy-Duty Vehicle Transmission Rotation Efficiency under Big Data Analysis
Automatic transmission is composed of hydraulic torque converter, gear transmission, hydraulic device, electric control device and shell. In use, the failure rate of hydraulic torque converter, electronic control device and housing is very low, and the failure of automatic transmission is generally in gear transmission and hydraulic device. The failure of hydraulic device can not only directly cause the damage of gear transmission, but also directly affect the performance and life of
automatic transmission. Therefore, the detection of hydraulic device is very important in the fault diagnosis, repair and performance test of automatic transmission.

2.1. Introduction of Big Data Technology

Input shaft drive to complete transmission noise detection at different gears; Output shaft drive for different gear shift test. Input motor speed adjustment is completed by frequency converter, output motor speed and torque set through the servo system. Sensor system and instrument complete the measurement and monitoring of output shaft torque, input and output end speed, transmission noise, injection and discharge flow rate, oil temperature, etc., which has been proved to be stable and reliable after use and can fully meet the production testing requirements[3].

![Figure 1. Internal control system of automobile transmission](image)

2.2 Set up Automatic Detection Framework for Transmission

Synchronizer is developed on the basis of joint sets of shift mechanism, which in addition to the joint sets, splined hub, corresponding to the joint of the gear on the gear ring, also added a joint sets and the corresponding joint ring gear circumferential speed quickly achieve and maintain a consistent mechanism, and prevent the prior to achieve synchronization into the joint in order to prevent the impact of the institutions [4]. There are some types of synchronizer, such as atmospheric pressure type, inertial type, self-increasing type, etc. The following formula can be used to calculate:

$$N = wT$$

Assuming that the output power of the engine remains unchanged, the power can be expressed as $N$, where $w$ is the angular velocity of rotation and $T$ is the torque. When $N$ is fixed, $w$ is inversely proportional to $T$. So growth must decrease torsion, deceleration must increase torsion. According to the principle of variable speed and torque, the gear transmission of automotive transmission is divided into different gear ratios to adapt to different operating conditions[5].
The transmission has to be in the gear of the switch, and it has to be equal to the circumference of the rodent, so that it can get into the meshing and get in the way.

3. Automatic Monitoring and Analysis of Heavy Duty Vehicle Transmission

When the gear teeth are out of sync, it is inevitable that there will be impact and noise due to the speed difference between the two teeth. In this way, not only is it not easy to hang gear, but also affects the life of the tooth, so that the tooth end wear and even fracture.

3.1. Determination of Automatic Monitoring Methods for Transmission

In order to make the shift smooth, the driver should take more complex operations and finish it quickly and accurately within a short time[6]. This can cause fatigue even for skilled drivers. Therefore, measures should be taken on the transmission structure to ensure smooth transmission and simplify operation to reduce driver's work[7]. The synchronizer is designed to meet this requirement.
According to the energy transmission characteristics of the heavy-duty vehicle transmission system, the energy flow during the operation of the heavy-duty vehicle transmission system is established, and the power transmission characteristics, energy consumption components and energy consumption characteristics of the heavy-duty vehicle transmission system are analyzed. On the basis of this study, the energy transfer mathematical model of the transmission system is proposed from the perspective of the system.

**Table 1. Heavy auto transmission information table**

| constitute       | Axial type | steel ball     | Oil consumption rate |
|------------------|------------|----------------|----------------------|
| Transmission     | Two        | Axial movement | 38.2%                |
| Input shaft      | Three      | Vertical downward | 28.3%              |
| Visual technology| Two        | Indentation grooves | 22.6%            |
| Shift element groove | Two        | Vertical downward | 34.9%          |
|                  | Three      | Indentation grooves | 24.7%          |

Through the electrical control system to control the input motor, output motor power switching, to achieve the simulation of vehicle working conditions. At the same time, the hydraulic system is used to control the clamping of the transmission, the lubrication oil injection into the transmission, the disconnection and closure of the clutch at the input end, and the advance and retreat of the tail seat at the output end. The injection and drainage device for input assembly mechanism, output assembly mechanism and transmission is designed. Through ipc, data communication between servo controller, frequency conversion controller, PLC and each instrument and output of data report are realized, and real-time control is achieved[8].
I was driving shaft, II is driven shaft. Might as well set is the number of teeth on the drive shaft gear $Z_1$, speed for $n_1$, torque for $T_1$, the number of teeth on the driven shaft gear is $Z_2$, speed of $n_2$, torque for $T_2$. Because the gears connect to the rigid connection, the main force of the action on the wheel is the same as the linear velocity on the wheel, which is:

$$n_1 \times Z_1 = n_2 \times Z_2 \quad (2)$$

This ratio is denoted as $I$ and its name is transmission ratio. If the friction and other power losses during transmission are not recorded, the power obtained from the driven gear is equal to the power of the driving gear, namely, $n_1 \times T_1 = n_2 \times T_2$, and $n_1/n_2=T_2/T_1$ can be obtained by combining these several expressions, and the following expression can be obtained:

$$i = n_1 / n_2 = Z_2 / Z_1 = T_2 / T_1 \quad (3)$$

Can be seen from this formula: if the number of teeth on the driving wheel less than driven pulley, the $Z_1 < Z_2$, namely $I > 1$, the $n_1 > n_2$, visible $n_2$ driven shaft speed dropped, then look at torque relations, can get the $T_2 > T_1$, $T_2$ increases the visible of the driven shaft torque, this is the slow increase torque; Conversely, if the active wheel has more teeth than the driven wheel, the rotational speed of the driven shaft will increase and the torque will decrease.
When above knowable, monitoring, must first put their own safety as the first, in the process of monitoring, the various units and enterprises to give full play to make every effort to ensure that technology and use, increase the effectiveness of the monitoring, avoid the happening of monitoring error.

3.2. Heavy-Duty Car Transmission Efficiency Auto-Monitoring Method Embedded
The automatic monitoring method of the transmission rotation efficiency of heavy-duty vehicle transmission is proposed on the basis of such a society to relieve the psychological pressure of the staff and enable them to concentrate on their work. If no intelligent monitoring personnel consciousness, and without professional training blindly, work, work is likely to cause errors and even lead to the accident, the staff if you don't have good physical quality and psychological quality, also be the work of heavy auto transmission efficiency of rotational monitoring, therefore, monitoring personnel before work must be conducted test and professional training, to understand the characteristics of artificial intelligence and characteristics, in particular, the prediction model is embedded process is shown in Figure 6.

Based on the fact that the transmission efficiency of the transmission is based on the change of speed, load, oil, fluid, and so on, the transmission efficiency mathematical model of the transmission efficiency of the transmission is presented. Compared with the calculation of the fixed value for efficiency, the calculation results of the proposed model are more accurate, providing a basis for the prediction of transmission power loss and the selection of vehicle power train.

4. Simulation Experiment
The theoretical analysis model of transmission efficiency of automobile transmission is established through the analysis of factors affecting transmission efficiency of automobile transmission. According to the transmission structure of the gear transmission, the transmission efficiency of the gear transmission is calculated.
Figure 6. Automatic monitoring flow chart

4.1. Preparation of Test Data
Measured results have good consistency with the theoretical calculation results, which demonstrate the validity of the theoretical model, for auto transmission efficiency calculation of prediction and provide the basis for the optimization of automotive power train system matching.

4.2. Analysis of Test Results
As a new high-tech monitoring method, the automatic monitoring method of the transmission rotation efficiency of heavy-duty vehicles can effectively improve the scientific and innovative awareness of the monitoring personnel, reduce the psychological burden and pressure of operators, ensure the completion of the project on time and quality and quantity, improve the accuracy and effectiveness of the automatic monitoring method for the transmission rotation efficiency of heavy-duty vehicles, and analyze the simulation curve as shown in Figure 7.

Figure 7. Analysis curve of transmission energy consumption
According to the test curve results and the above fig, there has been a great innovation and reform in the automobile monitoring system in the background of rapid technological development, which has led to the importance of studying the automatic monitoring method for the rotation efficiency of the heavy automobile transmission, as well as the difficulty and necessity of building this task in various regions. Therefore, it is necessary to have special technicians to carry out scientific and technological innovation to fundamentally solve the problems of transmission efficiency monitoring and ensure the smooth operation of the transmission monitoring of heavy vehicles.

5. Conclusion
Both ends of the fork shaft are supported in the corresponding holes of the transmission cover, which can slide axially. All forks and paddles are elastic and fixed to the appropriate fork shaft. The upper end of the three- and four-shift fork has the paddles, and the top of the three- and four-shift fork and all the paddles have grooves. When the transmission is in neutral, the grooves are aligned in the horizontal plane, and the ball heads at the lower end of the fork lever are inserted into these grooves. Automatic monitoring of heavy duty vehicle transmission rotation efficiency.

Acknowledgment
This paper was supported by Quzhou Science and Technology Planning Project(No.2019001) and (No.2019007), Domestic Visiting Engineer School Enterprise Cooperation Project 201(FG2019163).

References
[1] Gansohr M. Method for determination of at least a drag torque effective on the input side of an automatic motor vehicle transmission[J]. Journal of Applied Physics, 2017, 89(12):7917-7923.
[2] Robak S, Machowski J, Gryszpanowicz K. Automatic Alleviation of Overloads in Transmission Network by Generation Curtailment[J]. IEEE Transactions on Power Systems, 2017, PP(99):1-1.
[3] Ghanavati A Z, Lee D. Optimizing the Bit Transmission Power for Link Layer Energy Efficiency under Imperfect CSI[J]. IEEE Transactions on Wireless Communications, 2017, PP(99):1-1.
[4] Grisanti E, Hohmann M, Huber S, et al. A Chemometric Approach for the Prediction of the Aging Levels of Automatic Transmission Fluids by Mid-Infrared Spectroscopy[J]. Talanta, 2017, 18(Suppl. 1):118-124.
[5] Schuchart J, Gerndt M, Kjeldsberg P G, et al. The READEX formalism for automatic tuning for energy efficiency[J]. Computing, 2017, 99(8):69-74.
[6] Wang J, Fan Q, Zhang S, et al. Ultra-thin plasmonic color filters incorporating free-standing resonant membrane waveguides with high transmission efficiency[J]. Applied Physics Letters, 2017, 110(3):031110.
[7] Chang P, Miao G. Energy and Spectral Efficiency of Cellular Networks With Discontinuous Transmission[J]. IEEE Transactions on Wireless Communications, 2017, 16(5):2991-3002.
[8] Lee J, Lee K, Cho D H. Stability Improvement of Transmission Efficiency based on Relay Resonator in Wireless Power Transfer System[J]. IEEE Transactions on Power Electronics, 2017, PP(99):1-1.