Research and Application of Fault Diagnosis Method for Automobile Electronic Control Engine Based on Data Stream Analysis

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Abstract. In the process of diagnosing automobile electronic control engine faults, using data flow analysis methods as the main fault diagnosis work can not only improve the efficiency of fault diagnosis, but also have a positive significance for the development of China's automobile industry. The engine is not only the main component of the automobile, but also the key content that must be paid attention to in the development of the automobile industry. Once a car engine fails, it will have a great impact on the operation of the whole car. In order to be able to accurately grasp the specific fault conditions of automobile electronically controlled engines, we need to use effective fault diagnosis methods for analysis. At present, the application of dynamic data flow and static data flow analysis methods can accurately grasp the actual situation of the engine to a large extent. The use of data flow analysis to carry out effective troubleshooting and handling of the cause of the fault can reduce the possibility of engine failure. Experts need to analyze the specific conditions of the data flow during the research process, and discuss the specific application of the data flow analysis method in the process of automobile electronic control engine fault diagnosis. Thereby it can provide accurate reference for the fault diagnosis of automobile electronic control engine, ensure the safe operation of automobile electronic control engine, and improve the production efficiency of automobile enterprises.

1. Introduction
In recent years, China's technology industry has developed faster and faster, and the application of dynamic and static data streams is an important point in the development of the current automotive industry. During the application of dynamic data flow, fault diagnosis and maintenance of automobile engines can be carried out. This is beneficial to improve the durability and safety of automobile engines and protect people's lives. Strengthening engine research and innovation during the development of domestic auto companies in China and reducing vehicle exhaust emissions are an important part of promoting the sustainable and long-term development of the automotive industry. Therefore, we need to pay attention to the comprehensive application of electronic control technology and information flow system, strengthen the overall structure inspection and testing of automobile engines, and reduce the possibility of failure of automobile electronic control engines. In the process of fault diagnosis, relevant technical personnel need to use data flow analysis technology to fully grasp the specific fault conditions of the automobile's electronic control engine. At the same time, relevant staff need to take targeted measures to ensure that the car is in the best operating condition and prolong the service life of the car's engine.
2. Overview of Automotive Data Flow System

2.1. Automotive Data Flow Concept

It is necessary to fully grasp the main content of the data flow to apply the automobile data flow system when diagnosing the fault of the automobile electronic control engine. Automobile data flow analysis mainly refers to the use of electronic control units and sensors to connect to complete the process of data information transmission, and to interpret the specific operating status of the internal system of the engine through the equipment of automobile fault diagnosis. In this process, the data will have some changes due to the length of time the engine has been used and the state of internal parts. When detecting engine failures, the effective application of data streams can be visually expressed using data information. In this way, the staff can accurately grasp the pressure and working status of different sensors and prevent the engine from malfunctioning. In addition, this can reduce the work intensity and workload of the technicians. Moreover, the relevant staff can carry out fine inspection and maintenance work according to the key parts of the engine, reduce the possibility of engine failure during operation, and ensure the safety of the car [1]. In the application process of data flow analysis technology, it is mainly to display the numerical parameters and status parameters. In the management and supervision, only the magnitude of the value or the switch is displayed to correspond to the status of the various parts of the car. This not only facilitates the management personnel to understand the specific situation, but also provides accurate and reliable data reference for the maintenance staff, and facilitates the smooth progress of the follow-up work. Data flow analysis system is an important technology type that promotes the stable and sustainable development of China's automobile industry. Researchers need to master the main components of the engine electronic control system when researching the automobile data stream fault diagnosis system. It includes an electronic control unit and a control system, the specific composition is shown in Figure 1 and Figure 2.

![Figure 1 The Composition of the Electronic Control Unit](image1)

![Figure 2 Control system composition](image2)
2.2. The Function of the Car Data Stream
The main functions of applying the data flow analysis method in the process of diagnosing automobile electronic control engine faults are shown in the following aspects. Firstly, the application of the data flow analysis method can ensure that the engine electronic control system is in normal operation. The engine's ECU is mainly calculated and judged by the data stream provided by the sensor on the controlled object, that is, the physical parameters and working state parameters of the engine's electronic control system. In the process of data stream analysis. In this way, the actuator can control the controlled object, that is, the engine, within the allowable range after receiving the control data flow signal sent by the ECU. Secondly, the automobile data flow can accurately monitor the specific operating state and working conditions of the engine, and the specific working state of the automobile can be recorded during the application of the data flow analysis method. Meanwhile, in this way, the engine speed, temperature and other parameters can also be displayed by the car display. Thirdly, the automobile data stream can detect and diagnose the fault condition of the automobile electronic control system. In the application of the data flow analysis method, the diagnosis interface, ECU input or output port is mainly used to obtain relevant data information through the fault diagnosis instrument. The specific process is shown in Figure 3. Maintenance personnel can compare and analyze the obtained values and standard values, and can judge the specific operating status of the engine-related electronic control system. In the meantime, maintenance personnel can accurately judge whether there are faults in related system components or lines. Fourth, the data flow analysis method can also be used to self-diagnose the failure of the automotive electronic control system. During the operation of the electronic control system, the controller uses the fault self-diagnosis program to compare the input data stream with the standard parameters. If the input signal exceeds the normal range or is lost, it can be diagnosed as a fault in the circuit or component that provides the signal, and the fault information can be stored in the RAM in the form of a code.

![Figure 3. The Process of the Fault Diagnosis Instrument Acquiring Data Stream](image)

2.3. The Role of Car Data Flow
In the process of automobile electronic control engine fault diagnosis, the data flow analysis method is mainly used to obtain engine ECU input and output data by using certain methods, and analyze these data. In order to grasp the working status of the car and judge the specific operation of the engine electronic control system in time, it is helpful to find the malfunction of the engine in a short time. The application of the automobile data stream analysis method can supplement the automobile fault self-diagnosis, which is beneficial to improve the accuracy and reliability of automobile fault diagnosis. In the process of overhauling the automobile electronic control system, the data stream can be obtained by using a special or general fault diagnosis instrument and a digital multimeter. Simultaneously, experts can understand the actual operating conditions of automobile engines by analyzing and integrating data streams. The main functions of data flow analysis methods are shown in the following aspects. Firstly, a comprehensive analysis of the acquired data stream can more comprehensively monitor the specific operating status of different sensors and actuators of the engine
electronic control system. This is not only beneficial to grasp the real-time condition of the engine, but also to accurately judge whether the electronic control system is in a normal operating state. Secondly, the computer system can effectively diagnose the electronic control engine system without fault codes or error fault codes. The most reliable way to diagnose this situation is to use the fault diagnosis instrument to obtain the static or dynamic data flow of the automobile electronic control system. In this way, different parameters in the data stream can be analyzed, and the specific cause and location of the fault can be accurately diagnosed [2].

2.4. Classification of Data Flow Analysis Methods
When applying the automobile data flow analysis system, relevant staff need to accurately classify it. At present, the classification methods of automobile data flow mainly include the following three. First, it is classified according to the difference of the data display method, which mainly includes two kinds of numerical parameters and state parameters. Second, classify according to the flow direction of the data stream, which mainly includes input parameters and output parameters. Third, according to the operation process of the automobile data flow, the specific working state of the electronic control system mainly includes static data flow and dynamic data flow. These two data stream analysis methods are currently commonly used data analysis methods in the fault diagnosis process of automotive electronic control engines. They can improve the efficiency of fault diagnosis and ensure the reliability of the diagnosis results.

3. Automobile Data Flow Analysis Method
When applying automobile data flow analysis methods, experts need to have a comprehensive grasp of different data flow analysis methods. Only in this way can the appropriate analysis method be selected according to the actual situation of the engine and the reliability of the fault diagnosis result can be guaranteed.

First, data analysis methods. The data analysis method can be used to comprehensively analyze the data information transmitted by the sensors in the automobile engine, which is beneficial to grasp the change law and specific characteristics of the data information. Comparing the mastered changes with the standard values can determine whether there is any abnormality in the electronic control engine of the car in time. At the same time, in the process of applying data analysis methods, experts need to conduct in-depth research on the changing laws of values and the impact of the environment. Experts should improve the accuracy and reliability of data monitoring. Only in this way can the accuracy of fault judgment be guaranteed, and it is convenient for technicians to find the specific cause and location of the fault in time. Besides, this can also quickly carry out maintenance work and reduce the negative impact of engine failure on the car itself.

Second, the time analysis method. In the application process, it mainly counts and arranges the acquired data information. In the process of data statistics integration, relevant staff need to conduct a comprehensive analysis of the influencing factors of the data and study the specific fluctuation range of the data. In order to grasp the cause of the engine failure and the specific location. In the application of time analysis methods, relevant staff can promote the comprehensive and scientific development of future data flow technologies. This can not only ensure the reliability of automobile engine fault diagnosis, but also has positive significance for promoting the stable development of the automobile industry.

Third, the causal analysis method. This kind of analysis method is generally to analyze the data information in the automobile control system, which can effectively manage and research the data module. In the application of causal analysis methods, more attention is paid to the value of real-time engine monitoring. Experts must ensure that the engine value is within the normal range. Only in this way can the possibility of car breakdown be reduced. If there are abnormal fluctuations in the data during the application of the causal analysis method, the expert should contact the technician in time to check and maintain the abnormal parts. This can prevent abnormal problems from recurring [3].

Fourth, the method of association analysis. It is also common to apply correlation analysis methods
when using data flow analysis technology. In the application process of the correlation analysis method, after reading the data stream and the fault code, the expert also needs to conduct a comprehensive analysis of the associated data value to determine whether the relevant value meets the normal standard requirements. If it does not meet the requirements of the standard, the expert shall conduct a comprehensive inspection of the faulty part according to the specific value change. The correlation analysis method can check the automobile parts related to the engine, which is helpful to improve the overall diagnosis level of the automobile.

Fifth, comparative analysis method. When diagnosing automobile engine faults, comparative analysis methods are also commonly used methods. This analysis method can compare and analyze automobile engines of the same model. In this way, real-time monitoring of automobile engines can be carried out in the same external environment, and the transmitted data information can be compared and analyzed, so as to grasp the specific working status of the internal system of the automobile. In the application process, the comparative analysis method can not only help the technicians quickly understand whether the automobile engine is in a normal operating state, but also help to find the engine malfunction in time. Furthermore, this not only reduces the damage to the car caused by the failure of the car engine, but also prolongs the service life of the car engine [4].

4. Application of Data Flow Analysis Method in the Process of Fault Diagnosis of Automobile Electronic Control Engine

4.1. Fault Diagnosis Instrument
When using dynamic and static data flow analysis methods to diagnose faults in automotive electronically controlled engines, the instruments and equipment that need to be used mainly include fault diagnosis. The fault diagnosis instrument used in this research is KT600, which integrates multiple functions such as a decoder and a dedicated oscilloscope for automobiles, which can improve the efficiency of fault diagnosis to a certain extent. The instrument mainly includes four parts: a host, a diagnostic box, an oscilloscope box, and a printer. Different parts also have independent functions and functions. These 4 parts can be used separately during specific use, or they can be comprehensively applied according to the specific fault diagnosis requirements of the automobile electronic control engine. Among them, the host, diagnostic box (oscilloscope box) and printer can be combined into a whole by plugging. In addition, in the application process of the fault diagnosis instrument, it is also equipped with automotive diagnostics and online upgrades such as test extension cords, power extension cords, first cylinder signal clips, cigarette lighter plugs, car alligator clips, and various test plugs. The following application points need to be paid attention to during the use of this fault diagnosis instrument. Firstly, the user should read the instruction manual of the instrument in detail before use, and accurately grasp the specific application requirements of the fault diagnosis instrument. This can prevent misoperation during later use. Because the fault diagnosis instrument is a precision electronic instrument, it should be prevented from being bumped during use. Moreover, this can also prevent the instrument and parts from contacting high temperature objects or corrosive liquids during the use of the instrument. Secondly, it is necessary to correctly select the test plug before use. If the diagnostic socket does not have a power supply, an external power supply is required. In order to ensure the safety of the external power supply, the user needs to use the red alligator clip to connect the positive electrode of the battery and the black alligator clip to the negative electrode of the battery to prevent damage to the instrument due to reverse connection. If the keys do not work or the program is interrupted after the instrument is turned on, the user needs to disconnect the power and start the test again. The user must ensure the reliability and stability of the connection between the test plug and the diagnosis during use.

4.2. Use Dynamic Data for Analysis
When analyzing the application of dynamic data streams, experts need to take a certain brand of car with the engine model AJR as the main research object. The main fault of the car is the sudden
increase and decrease of the engine idling speed. Experts need to start the engine when using dynamic data flow to troubleshoot faults, and use the read data flow function of the fault diagnosis instrument to obtain data. After obtaining the data, the engine speed is 870 rpm, the engine load is 1.0 ms, the throttle angle is 3.47°, and the ignition advance angle is 12°. The fuel injection pulse width of the car's engine is 2.28ms, and the intake air volume is 2.02g/s. The car’s displayed intake air volume and engine speed signal have abnormal changes, and the car’s intake air volume signal value is low. Experts can use a digital multimeter to further inspect the engine and find that the air flow sensor has abnormal changes and is in a malfunctioning state. The user can complete the flow sensor replacement work and test run. If the engine is running smoothly at idling speed, the air intake signal measurement task can be completed at the same time, and the value is within the normal range [5].

4.3. Use Static Data for Analysis
Experts need to take a certain brand automobile with the engine model EA111 as the research object when researching the static data flow analysis method. The main problem of the car is that the engine is difficult to start after the car stalls. When using the data stream analysis method to troubleshoot the fault, it is necessary to connect the faulty car to the fault diagnosis instrument to read the static data stream of the car. In this way, after entering the function of reading data stream, the engine does not start. If the actual temperature of the coolant is 20°C, it can be judged that the signal from the coolant temperature sensor of the car to the ECU is abnormal. In order to verify the specific conditions of the fault, the user needs to use a digital multimeter to measure the water temperature sensor and display that there is no fault code output. Experts can learn that the car owner has cleaned the engine with a water gun after inquiring about the car owner. Therefore, it can be judged that the coolant temperature sensor needs to be replaced because the signal output of the coolant temperature sensor is abnormal due to the wrong operation of the vehicle owner. Afterwards, carry out a test run, and if it is found that it can be started normally, the fault can be eliminated [6].

5. Conclusion
All in all, in the context of China's rapid social and economic development, China's automobile industry is developing faster and faster, and the economic benefits of the automobile industry are constantly improving. In order to ensure the development level of the automotive industry, experts need to fully apply advanced science and technology and management models to promote the sustained and stable development of my country's automotive industry. In the development process of the automobile industry, the automobile engine is the main core among them. In this way, it is an important foundation to ensure the safety of the car to prevent the car engine from malfunctioning. As a result, experts need to pay attention to engine management and research and development to promote the long-term development of China's automobile industry. In the management and maintenance of automobile engines, experts should use effective technology to find out the specific reasons and locations of engine failures in time. Only in this way can we take targeted measures to solve the fault according to the characteristics of the fault and ensure that the engine is at the normal operating level. The data flow analysis method is currently one of the main methods for diagnosing the fault of the automobile electronic control engine. The diagnosis efficiency of this method is relatively high, and it can accurately determine the specific fault location and characteristics of the engine. In the application process of data flow analysis methods, experts need to fully grasp the static data analysis methods and dynamic data methods according to the specific conditions of the data analysis flow. This can improve the reliability of engine fault diagnosis results. This can not only improve the efficiency and quality of engine maintenance, but also reduce the damage to the car caused by engine failure, and ensure the overall performance of the car engine.

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