THE EFFICIENCY OF AUTOMOTIVE VEHICLES BASED ON INTELLIGENT ONBOARD SYSTEMS

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Absract: *Broad automotive engineering in modern agricultural technologies results in the need to improve the operational characteristics of internal combustion engines. In this regard, the internal combustion engines are increasingly stringent requirements in terms of energy conservation and environmental safety. Improving the efficiency of operation of the engine is reduced to the complex optimization of the main variables and parameters of motors with absolute quality assessment used in these fuels. For a comprehensive optimization should be linked all the characteristics of the engine through certain values and parameters. When using fuels of different quality formulated problem is modeled as a multiobjective multi-parameter optimization. One way to solve this problem is the application of the guideline systematic approach - the principles of hierarchy. Management of automotive equipment by using on-Board devices, the functioning of which is considered at the level of subsystems of the engine. The basis for the partitioning of the engine on the levels is the structure, the relationship between the elements and features of their functioning. The interaction of the subsystems is reduced to the implementation of vehicle specified performance properties of the command signals from the electronic engine control systems. Decomposition of the hierarchical structure of the engine should be limited to three levels. During the development of the automated engine management system used in the dynamic system of the engine as the control objects, simulation, mathematical optimization techniques, special simulation setup and debug systems. In the result, we developed several technical solutions: automated system bench testing of engines and simulation of dynamic stand electronic control systems for internal combustion engines.*

KEYWORDS: ADAPTIVE CONTROL OPTIMIZATION OF THE INTERNAL COMBUSTION ENGINE, ELECTRONIC CONTROL SYSTEM, THE EVALUATION SYSTEM OF FUEL QUALITY, AUTOMATIC CONTROL.

Introduction

The fuel used in automobiles and tractors transport enterprises, has a certain level of quality, strong physico-chemical and performance properties. These properties provide some level chemmotology reliability equivalent to a certain amount of useful work (groundwork). The energy conversion system of the engine is characterized by thermodynamic and workflows teplovydeleniya and heat loss, which is based on the chemmotology the processes of conversion of fuels that determine performance characteristics. At high content of contaminants, sulfur and nitrogen can form sulfur dioxide, sulfates, and oxides of nitrogen, problems of environmental pollution sredy. Currently represents bolsta difficulties determination of properties of potential fuels for future engines. Therefore, it is impossible to accurately assess their physical and chemical properties. Nevertheless, in the literature ,[], data analysis of the nature of primary energy sources, as well as characteristics of processes for producing fuels we can make a clear performance about the properties of future fuels. A significant number of existing qualitative and quantitative methods of control of certain properties of fuels are time consuming and expensive and require organizatsii specially equipped laboratories, which requires significant expenditures for their maintenance. To improve the reliability of automotive engineering and ensure its quality fuel it is necessary to develop universal methods of quality control of fuels in the formation of its physical and chemical properties directly on the engine.

Preconditions and means for resolving the problem

The main objectives of the rapid assessment of quality indicators of fuel are:

- the definition of an integrated indicator for subsequent exposure to the operated object to increase its life and reliability of the work;

- the regulation of the fuel injection equipment of the engine of automotive engineering for optimal performance when using a certain brand of fuel;

- improving the quality of fuel entering the engine, by forming the optimal physico-chemical composition.

The indicator of fuel quality is a quantitative characteristic of one or more properties constituting the concept of "quality No. defined in absolute or relative terms. The properties and performance of lower level are an integral part of the complex index of quality. A comprehensive indicator of the quality expressed by the function:

$$Nk^1 = f\left(N_1^2\, N_2^2 \dots\dots N_k^2\right) \quad (1)$$

For the additive model of comprehensive quality index can be calculated by the formula:

$$N^1 = \sum N\, k^{1+1}\, \alpha_k \quad (2),$$

Where α_k - is the weighting factor of quality score.

The proposed method is based on an integrated approach to the evaluation of product quality based on the use of weighted-average. Using the expression (2), we get:

$$N = A_x\, B_y\, C_z \int \int_D \int \alpha_y dzdydz = \varphi_o \int \int_D \int \alpha_z dxdydz\alpha \quad (3)$$

where α_y - integrated quality score characterizing performance of the fuel; α_z - is the unit quality indicators received during testing of fuels; A_x - the weighting factor of the i group quality indicator; B_y - the weighting factor of the i complex indicator of quality; C_z - is the weighting factor of the i single quality indicator; ψ_o - a certain range of values of indicators of the quality of fuel of this type, regulated standards.

Composite measure of quality is difficult to determine, so the spacecraft is unknown analytical expressions quantitatively describing the inter-relationships of different nature processes and phenomena. Revealed that the most extensive factor contributing to the quantitative and qualitative characteristics of energy conversion in internal combustion engine, is developed by the fuel utilization factor k_i:

$$K_i = \frac{\lambda N_e}{q_c} \quad (4)$$

λ - the coefficient characterizing the energetic properties of the fuel, the efficiency of conversion of heat into mechanical work;

N_e - the effective power of the internal combustion engine;

Q_c - cycle fuel.

This composite measure of quality of fuel was developed in the aim of selecting and using the different fuels, which has the potential in energy and environmental respect.

For the rational implementation of quality indicators used fuels necessary operational control of its main energy

indicators, which ensures reliable operation of the engine of automotive vehicles. Conclusion on the compliance of fuel quality standards is not given by all indicators, but only on the fuel utilization factor. The best way to implement the quality control process of the fuel's physical and chemical composition is the adjustment of the operation of the engine by adjusting the fuel system using a feedback system that will protect the engine, its parts and components from premature wear. Generalized scheme of the principle of feedback control system and assess the quality of the fuel based on detection of the deviation of the actual state of the object *x* from a given state *y* and convert it into a control action *u*, is presented in figure 1.

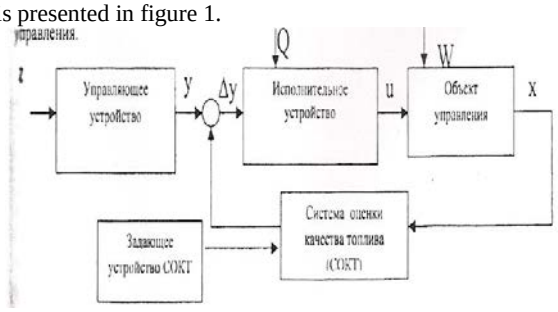

Figure 1. *The scheme of the control system of fuel quality control with feedback*

z –effects, y – control effects, Δy – deviations, Q- additional external energy, u – increased operating influence, W – the disturbance, x –the actual state of the control object.

More clearly the measurement determination process can be represented as a three-tier management information model for assessing the quality of fuel on the tractor, is presented in figure 2. In this case, the control system of assessing the quality of fuel can perform the functions of a local controller at the first level of the single multi-level system of governance.

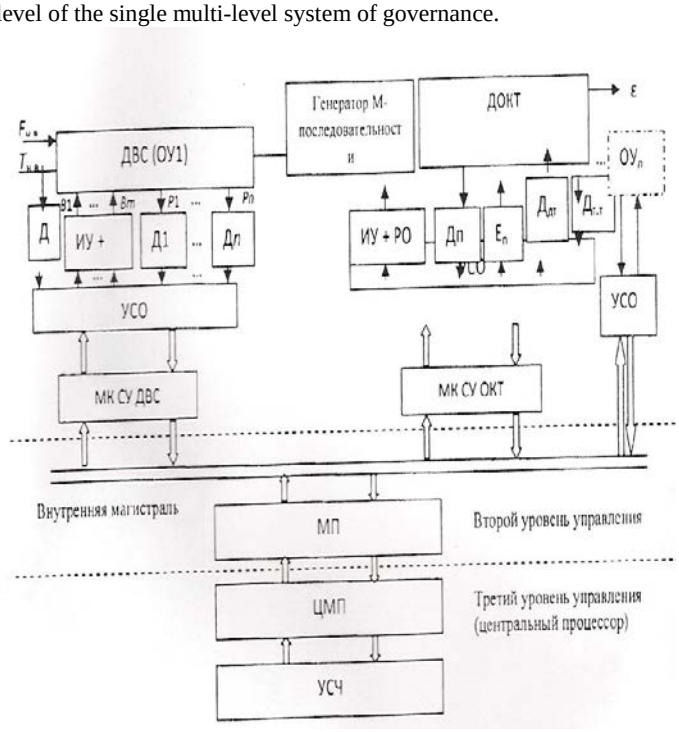

Figure 2. *Three-tier data management model system for the evaluation of fuel quality on the tractor.*

On the first level is the management of local objects that control the subsystems, which can be various kinds of regulators. The second microprocessor control system provides comprehensive coordinated management systems of the car. In such systems includes power unit, power system, power transmission, lighting equipment, salon equipment, security systems and accessories. On the third level of the Central microprocessor control system is an automated control system, connected through interfaces to a person. These devices are indicators and controls that are used by the driver when steering the tractor. By the fourth level control, not shown in figure 2, are the systems used by the driver and maintenance personnel in the operation of the vehicle and its maintenance. One of the main objects of management is the DBC.

Its parameters are determined by the sensors D1-Dtg. After ag6reeing on all the parameters in the management of the evaluation system (UCO), signals are sent to the microcontroller of the control system of the internal combustion engine (MK CY DBC). Control commands via UCO do n actuators IU and regulators of PO for the impact on the engine and its systems. The objective of UCO is for the conversion of analog signals into a corresponding code, and the coded signals at the input of the microprocessor into analog signals.

The second control object in the diagram is the system for evaluating the quality of fuel (COK). The parameters obtained from the temperature sensors fuel Dtg, evaluation of fuel quality Dn, the voltage of the generator En, microcontroller system for the evaluation of fuel quality controls the parameters of fuel injection and ignition timing of the internal combustion engine. If necessary turns on the generator M-sequence that provides the conductivity of the fuel, which facilitates the operation of sensor evaluation of fuel quality. MK SU OKT can program to carry out the manipulation of fuel, given the performance of the fuel. This system greatly facilitates the operation of automotive tools and prolongs its service life. Standardization of interfaces (exchange protocols) communication channels and selects the best Protocol in upravlaushiy subsystem is the most important challenge in designing information control networks for road transport information and control network.

Considering the developed scheme for hierarchical adaptive MIICU with assessment of fuel quality (COKT) the engine automatic control of motor parameters (set of adjustable parameters in relation to diesels reduced) (figure 3), the control unit calculates the motor parameters according to the position of the regulating sleeve, fuel temperature (DTT) and sensor evaluation of the quality of fuel (DOKT). The need for a system of assessing the quality of fuel (COKT) were evident in the Troubleshooting of electronic control systems in diesel engines. System of automatic control of parameters of the engine with a system for evaluating the quality of fuel (COKT) is presented in figure 3 two typical additional systems - closed and open. The first is the system of regulating the pressure of fuel which is formed by a pressure regulator and a channel of the motor, which converts electrical output signal of pressure signal u_d in the fuel pressure *p.* In the system of regulation of advancing of the injection fuel injection Q is formed founded regulator fuel with the output signal and secure channel engine.

Considered part of the control system (set local system management parameters) provides the engine with a given accuracy maintain its parameters in steady-state modes and necessary or even optimal duration and the maximum deflection of the quality of transient processes of control of engine parameters, primarily by the frequency of rotation.

The system of automatic regulation of frequency of rotation is not only important, but also the most advanced in terms of accuracy and speed local MPCU system of the engine. She plays a unique role in adaptive management, as produced by it managers influences the output signal of the regulator and its derivatives are used at all levels and in all types of adaptation.

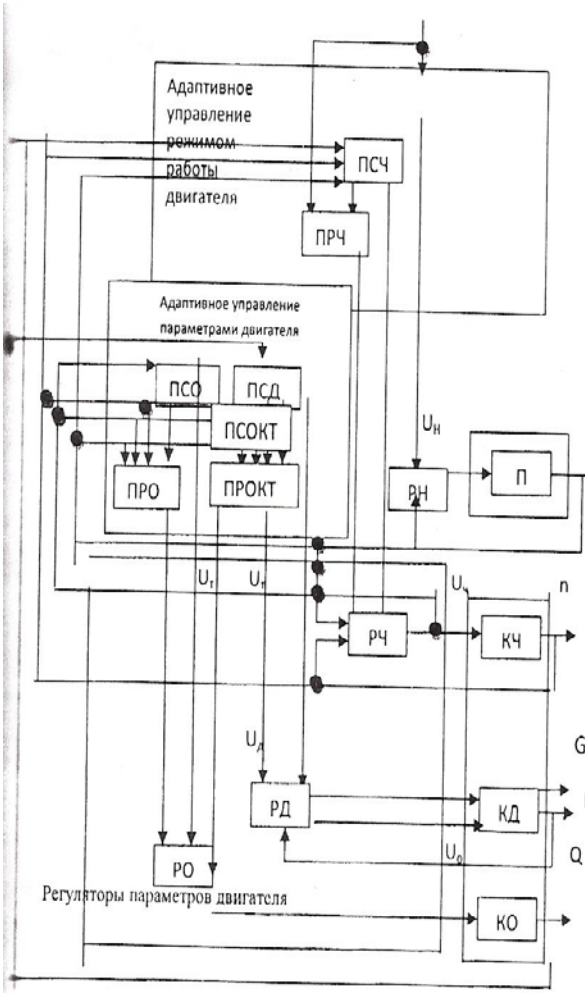

Figure 3. *A block diagram of a hierarchical adaptive MPOs engine with automatic control of motor parameters with the system of evaluation of the quality of the fuel*

The channel forming the rotational speed starts in the engine fuel system, which converts the output control signal of frequency u_c in cyclic supply of fuel. In KC consistently also includes a thermal link that convert fuel into torque, and a mechanical link to the engine that converts the difference between torque and moment of resistance in the frequency change rotation.

System of automatic control of engine parameters with the system of evaluation of the quality of fuel is closed, the current residuals, i.e. the difference between the specified and actual values of COKT filed at the RO and RD. The deviation of the measured parameters conductivity, respectively, the control algorithm is RO and RD forms u_d and u_o until then modifies this signal until installed them the fuel feed and the advance angle of injection into the engine is not going to come with a given accuracy to a value necessary for the optimal operation of automotive vehicles using different fuels. Such regulation (figure 4) provides high precision evaluation of fuel quality and achieve optimal management areas through a DOKT, as this reduces fuel consumption and improves performance.

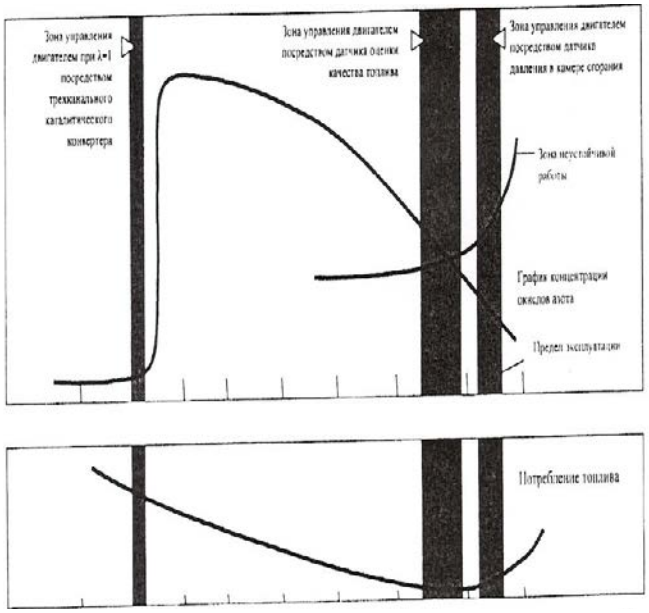

Figure 4. *Functional diagram of the adaptive control optimization of the internal combustion engine based on an assessment of fuel quality in different operational modes*

Conclusion

Thus , in a closed system changes u_t is the reaction of RD and RO for any made to system perturbations. This signal is most informative, as quickly and accurately expresses what is happening in MPCU processes. Since the fuel supply to the cylinders is proportional to..., then it is proportional and torque of the engine. Of course, the numerical value of the proportionality factor depends on fuel quality, combustion efficiency, speed, etc, therefore, it is impermanent. But to a first approximation , especially when sufficient stability of these factors, u_t reflects the instantaneous values of torque and power fuel (the most common optimality criterion), it can be used as a criterion for the optimal management of adaptazii engine, for that matter, and for other purposes. As a carrier of information about torque, fuel consumption, u_t eliminates the need for installing the engine sensors these parameters is quite complicated and expensive.

Search engines determine the changes in the job controller of the motor parameters needed for more accurate than software-adaptation, self-optimization mode. The search is performed by trial changes jobs appropriate regulator's assessment of the quality and fuel consumption caused by these changes.. For more options of changing cyclic fuel feed, the search engine in General need to control the fuel composition. These include the shape of the injection characteristics. As the optimality criterion in the quality of fuel at the SEMA used total (hour) fuel consumption and the efficiency of fuel use by the engine. In some cases, in the search device, you can use the battery based supply cycle from the pressure of the fuel in accumulator, with the limitations associated with the assessment of fuel quality on the output signal with the influence of the temperature of the fuel. When hard software control of the main parameters of the engine output the control signal to the fuel pressure quite clearly linked with them. Therefore, in a first approximation from can also be used for search engine adaptation by any parameters.

Once the search is completed and the output of the engine to the point of minimum flow adaptive system (Fig.4) according to the obtained data it updates the software algorithms and analysis of adaptation in the assessment of fuel quality (the content of the tables or coefficients of the analytical dependences). This allows to improve the accuracy of optimization during software adaptation engine depending on chemmotology properties of fuels of any particular sample and its application conditions.

A set of programmers and search engine management settings, engine forms the main (first) level of adaptive control optimization for internal combustion engine the assessment of fuel quality. Along with the optimization of the parameters of the motor in each mode there is a problem of choosing the optimal mode of operation of the engine. This task is solved at the second level of adaptive management.

Thus, adaptive optimization engine to assess the quality of fuel in the modes defined by the achieved speed and prilozenoj load produced by the circuit of Fig. 3-4 adaptive control device for which the control object is a set of local management systems options. The adaptive device is a second level in the structure of the management system, performing coordinated adaptive management of all controlled parameters of the engine. It is implemented as regulators of local systems in the microcontroller and consists of programmers and search engines. The programming is performed and the necessary amount of analytical adaptation. They choose the jobs regulators of engine parameters and perform software adaptation; job each of the regulators are formed by individual programmes in function of the actual rotation frequency applied to the motor load, other monitored parameters of the engine and the environment, as well as the output signals of the regulators of other local systems. Search engines are presented in the channels of pressure control and ahead, acting mainly in steady-state modes. Fundamentally search process as possible and in transients, but this is due to the need to increase the accuracy and performance of hardware and software. Therefore, the feasibility of their implementation requires in each case a special analysis. To optimize transient effective corrective actions on derived. The calculation of derivatives of the signals are organically present in the microcontroller, the most rational. The allocation is as optimized leading causes to the speed and accuracy of the systems of regulation of engine parameters when using the system for assessment of quality of fuel and maximum utilization of the output signal of the pressure regulator and its components at all levels and in all types of adaptation provide the greatest possible effectiveness of adaptive management.

Literature

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