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IDENTIFICATION OF FAULTS OF THE HYBRID ELECTRIC VEHICLE

A. Prykhodko, student, KhNAHU, D. Nikulin, student, KhNAHU

Abstract. *A new innovative method of hybrid vehicle diagnostics by spectral analysis of the supply current.*

Keywords: *hybrid vehicle propulsion, electric drive, spectrum analysis, simulation model of the drive, Fast Fourier transform*

ІДЕНТИФІКАЦІЯ НЕСПРАВНОСТЕЙ ЕЛЕКТРОПРИВОДУ ГІБРИДНОГО АВТОМОБІЛЯ

О.Д. Приходько, студент, ХНАДУ, Д.В. Нікулін, студент, ХНАДУ

Анотація. *Запропоновано новий інноваційний метод діагностики гібридного автомобіля за допомогою спектрального аналізу струму в колі живлення системи.*

Ключові слова: *силова установка гібридного автомобіля, електропривод, спектральний аналіз, імітаційна модель електроприводу, швидке перетворення Фур'є.*

ИДЕНТИФИКАЦИЯ НЕИСПРАВНОСТЕЙ ЭЛЕКТРОПРИВОДА ГИБРИДНОГО АВТОМОБИЛЯ

А.Д. Приходько, студент, ХНАДУ, Д.В. Никулин, студент, ХНАДУ

Аннотация. *Предложен новый инновационный метод диагностики гибридного автомобиля с помощью спектрального анализа тока в цепи питания системы.*

Ключевые слова: *силовая установка гибридного автомобиля, электропривод, спектральный анализ, имитационная модель электропривода, быстрое преобразование Фурьэ.*

Introduction

Hybrid cars, for now, is a promising development of automobile industry. Specifications cars with hybrid improves every year, thanks to competition car manufacturers. Therefore, at this stage of development of hybrid systems to the fore the issue of improving and optimizing its components as well as of the installation as a whole.

The purpose of this article

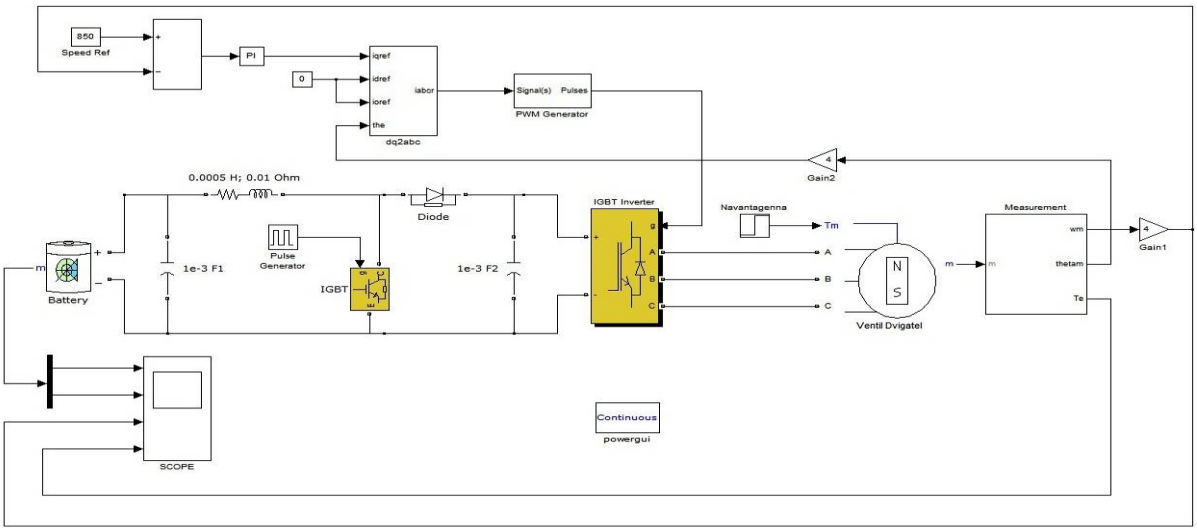
So in turn, I offer a new innovative method of fault diagnosis of hybrid electric vehicle, using spectral analysis of current into the mains system. This method is verified with the help of application package Matlab / Simulink. Through which created a simulation model of electric drive monitoring system and conducted the spectral analysis.

To identify the technical condition of the propulsion hybrid car should be - building a monitoring system of the simulation model of electric drive with brushless DC electric motor (in the driving mode). Simulating damage in a model of the propulsion on all the modes, with the help of harmonic analysis, to identify the damage.

A simulation model of propulsion segment of electric drive

For the virtual researchers constructed simulation model of electric drive system in the package application programs Matlab / Simulink.

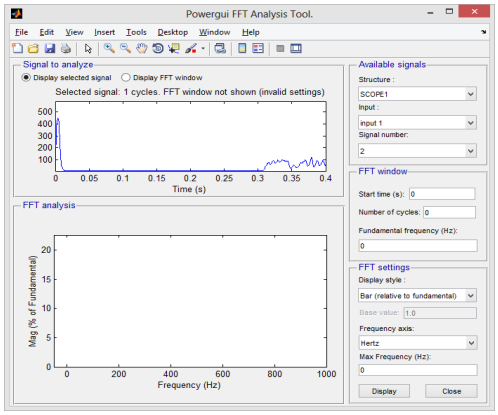
The program provides an opportunity to construct graphical block diagrams, simulate dynamical systems, investigate working capacity of systems and improve project. Simulink is fully integrated with MATLAB, which ensures quick access to a wide range of tools for analysis and designing. The complete model of power section of electric drive, consisting of a three-phase synchronous machine Ventil Dvigatel, controlled by three phase inverter IGBT Inverter, inverter control unit PWM Generator, coordinate convertor dq2abc and block Speed Ref that sets the rotation speed drive shown in pic.1.



Pic. 1. Scheme of the simulation model of the electric drive with brushless DC electric motor

Having built a simulation model of power section of electric drive analyze output characteristics obtained from the oscilloscope (SCOPE) and draw conclusions that the parameters of the system in serviceable condition at different modes of operation. For the diagnosis of the condition of the propulsion, it was decided to use the current from power supplies. Research current, by using harmonic analysis, turned the most informative indicator of system of all. Harmonic analysis is performed using the "Fast Fourier Transform".

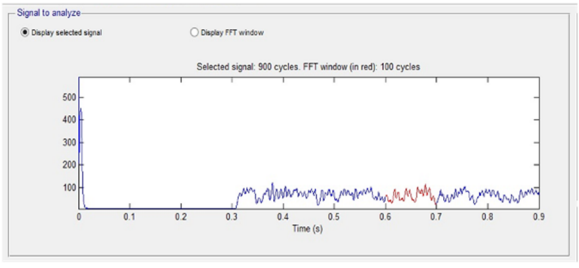
Investigation of the spectral composition at the program is implemented using Simulink block Powergui. After configuring we get the window Powergui FFT Analysis Tool which is shown in pic. 2.



Pic. 2. Window Powergui FFT Analysis Tool with the signal of current

Analysis of indicators

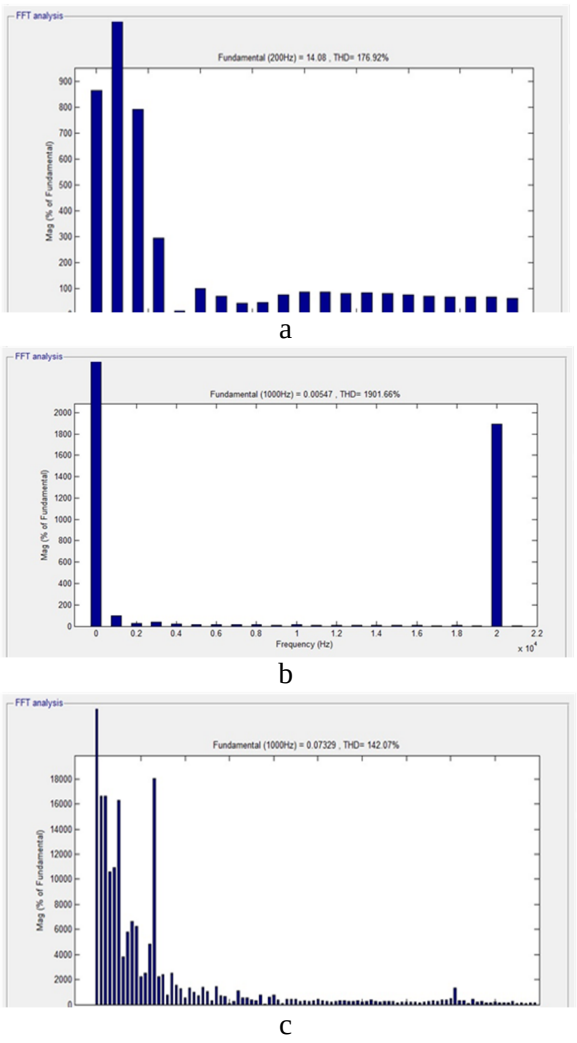
Analyze current signal that comes to oscilloscope pic. 3. from high-voltage battery.



Pic. 3. The current in the power supplier

For a more detailed analysis of current divide the current oscillogram into three zones:
- start, period of time t <0,05;
- idling, period of time 0,05< t <0,3;
- work under loading, period of time t >0,3.

Results of the analysis of spectral characteristics show: - start pic. 4, a;
- idling pic. 4, b;
- work under loading pic. 4, c.

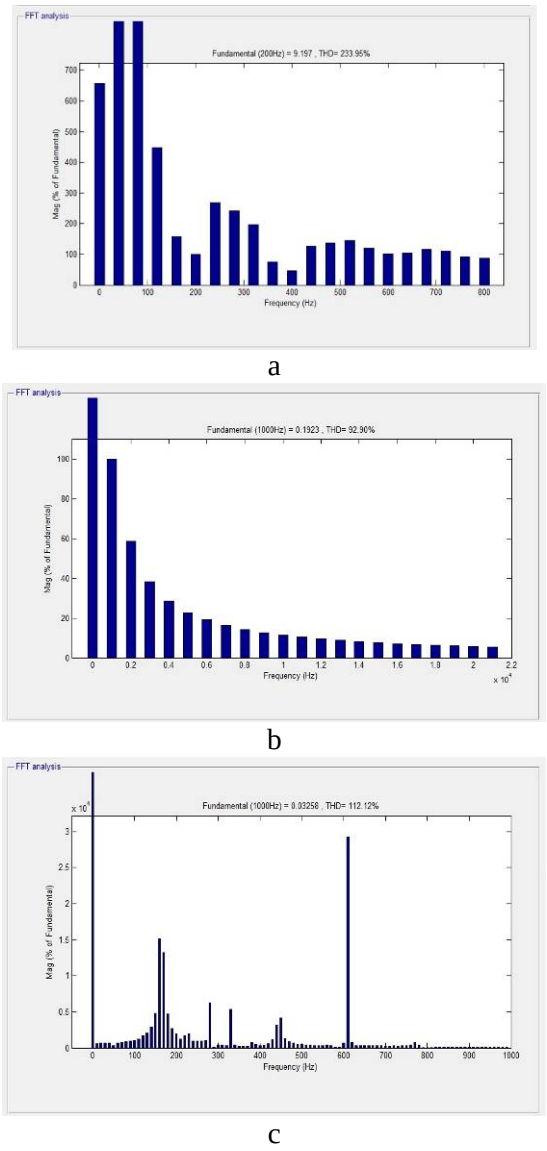


Pic. 4. Spectral characteristics of current functions: a – start; b – idling; c – working

The identification of structural damages of the system is performed on the basis of analysis of the periodic processes and by analyzing the spectral composition time functions of these processes. Simulated structural system faults (failure of system elements) is performed by switching or cut conductor in the schematic model of its elements. Consider the structural malfunction - no signal on the key of the voltage converter pic. 5.

Conclusions

By results of researches can be noted next. Having compared spectral characteristics of current in operative condition and fault condition of the models were able to detect differences between them. This led to the conclusion that our proposed diagnosis method is effective. To locate faults in electric drive should analyze signs their manifestation and perform spectral analysis of time functions of supply current.



Pic. 5. Spectral characteristics of the current functions with inoperative voltage converter: a – start; b – idling; c – working

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