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Modelling A Multichannel Signature Diagnostics Method in Multimedia Terminal Devices

Short Communication

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Abstract

The issues of analytical and simulation-based evaluation of reliability of controlling the multi-channel signature diagnostic method are described in this paper. The stages of the life cycle of technical means of data transmission systems and the ways of increasing their reliability characteristics are covered. Developed multi-channel signature method modelling algorithms and software to automate the identification of reference signatures for multi-output diagnostic devices. The analysis of modern microprocessor devices of data transmission systems as an object of control and diagnostics necessary for the selection of characteristics of methods of signature analysis is considered.

Keywords: Microprocessor sets; Signature analyser; multi-channel signature analyser; Single-channel signature analyser

Introduction

The report discusses the issues of assessing the reliability of the control of the multichannel signature diagnostic method of analytical methods and simulation modelling. Currently, the most demanded services are services with a comprehensive provision of information, which are defined as multimedia. The tendency to increase the amount of multimedia information inevitably leads to the need to create modern technologies based on multimedia terminal devices. To build modern multimedia terminal devices, an element base based on the use of microprocessor kits (MPK) is used. At the same time, the transition to the widespread use of MPCs in modern multimedia systems has created, along with indisputable advantages, a number of serious problems in their operational maintenance, primarily related to monitoring and diagnostics processes. In general, up to 70-80% of the recovery time of failed systems is the time of technical diagnostics, which consists of the time of searching and localizing failed elements. The classical strategy for testing digital systems, based on the formation of test sequences, requires a significant amount of time and large amounts of test information and reference output reactions, which requires complex equipment. The most effective solution that can significantly reduce the amount of stored information about reference [1-5] output reactions is a multichannel signature diagnostic method in multi-output digital circuits.

Analysis of an n-output digital circuit by a single-channel signature analyzer (SA) leads to an increase in n times the time required to analyze the circuit, or the equipment required to implement n signature analyzers. Multichannel signature analyzers (MSA) can significantly speed up the procedure for monitoring digital circuits, which practically increases by n times, where n is the number of inputs of the analyzer used. Taking into account the equivalence of the functioning of the n-channel signature analyzer and the corresponding single-channel analyzer with respect to the compression result of n input sequences $y_v(k) \in \{0,1\},\ v = \overline{1,n},$ it is possible to assess the reliability of the MSA using the results obtained for a single-channel signature analyzer. Indeed, in the case of using the primitive polynomial $\varphi(x)$ probability of not detecting errors in sequences $\{y_v(k)\},\ v = \overline{1,n}$ multichannel signature analyzer for $h = 2^m - 1,$ where m is the highest degree of the generating polynomial, will be determined by the relation:

$$P_n = \frac{2^{nl-m} - 1}{2^{nl} - 1} \approx \frac{1}{2^m}$$

This ratio is valid for any ratio n and l, whose product is equal to 2^m-1. The given integral characteristic of the MSA efficiency, as well as the characteristic of a single-channel signature analyzer, is a fairly approximate estimate that is fair for general assumptions. A more complete characteristic of the ISA will be the probability distribution P_n^{μ} not detecting a multiplicity error that has occurred in analyzed sequences $\{y_v(k)\}$ .In this case, the numerical value of these probabilities, as in the case of a single-channel analyzer, is determined by the expressions:

$$P_n^1 = P_n^2 = 0$$

$$P_n^{\mu} = \frac{1}{2^m - \mu}\left[1 - P_n^{\mu-1} - (\mu - 1)P_n^{\mu-2}\right],$$

$$\mu = \overline{3,2^m - 1}$$

The disadvantage of the considered analytical expressions is that they do not allow to evaluate the reliability of the MSA depending on the multiplicity and combinations of errors, taking into account the length of the analyzed binary sequence and the fault model.

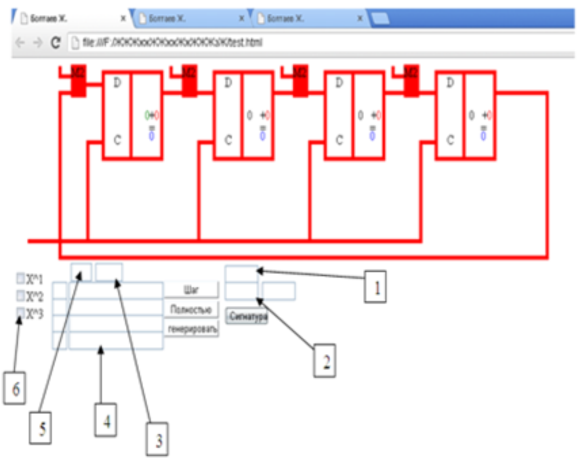

Figure 1: Multi-channel signature analyzer.

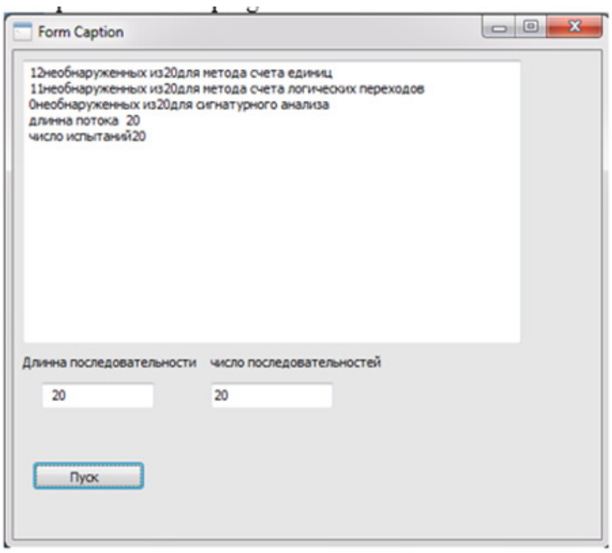

Figure 2: The program window to simulate the testing of SA.

Description of Simulation Model for Multi-Channel Signature Analyzer

Description of the virtual layout of the multichannel signature analyzer.

There are several definitions used in the model:

Numerical sets:

1-state flip-flops in the last clock cycle.

2 convolutions (signature).

3-input vector.

4-field display sequences.

5-fields for entering the length of the sequence.

6-field for setting up the feedback register.

Red symbols are the next incoming bit vector.

Symbols in black - the state of the previous triggers in the previous measure.

Green symbols - the state of the last trigger in the previous cycle (appears when there is feedback).

The blue symbols are the states of the triggers in the current bar.

In order to get a convolution, you must first enter the stream length (field No. 5), then click on the “generate” button and then on the “calculate” button during the last cycle of the analyser, in field No. 1 (the status of triggers in the last cycle of work) a binary sequence will appear that is not yet a collapsed signature, [5-10] then when you click on the “signature” button in field No. 2, a finished convolution will appear. You can also set feedback in field No. 6.

In addition, you can enter the desired sequences yourself, for this you need to indicate the length of the sequence in the field for specifying the length (field No. 5) and enter the sequences in the sequence display field (field No. 4) This program works on all operating systems that support browsers such as Opera, Mazilla firefox, Explorer. The figure shows the program interface for simulating the operation of a multichannel signature analyser for 4, 8, 16 bits (channels).

In order to obtain a quantitative assessment of the reliability of compact testing methods, including MCA, the following must be done:

- Develop algorithms and write PC programs for simulation of MCA methods, counting units, logical transitions and errors of binary sequences.
- Evaluate the reliability of compact testing methods for errors of various multiplicity and lengths of binary sequences.

The MCA simulation program is written in PHP using Devel Studio, the program code is placed in a separate application (shortcut). To simulate the operation of the MSA, it is necessary to enter in the appropriate column of the sequence their length and a polynomial that specifies the feedback of the register (a signature will be formed according to the given links), [11-15] then press the start button and the convolution will appear in the signature field. The program for modelling testing of multi-output DS includes 3 programs that allow you to calculate the number of undetected errors when testing multi-output digital devices for MCA on 4,8,16 channels.

For simulation, you must enter the length of the sequence (“Length” field) and their number, then press the start button and the program will display the simulation results for the method of logical transitions of counting units and signature analysis.

The following is an example of how the program works.

In order to compare the detecting ability of a single-channel SA with MSA, a program for simulating the work of the single-channel signature analyser (SSA) was also developed. For modelling, it is necessary to enter the length of the sequence in the “length” field, the forming polynomial in the “polynomial” field, the number of errors in the “errors” field, and the number of generated sequences in which errors will occur in the “sequences” field. Then click the generate button to generate the sequence or enter the sequence yourself.

At the beginning of the program, the program will display sequences with errors in this window.

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Based on the work of these simulation models, it was concluded that the detection ability for multi-channel and single-channel SA is the same.

Conclusion

An analysis of the characteristics of existing monitoring and diagnostic tools has shown that the methods and means of signature analysis are practically the only ones for use in operating conditions. Diagnostics of digital devices from the n-output by a SSA leads to an increase in the time required for device diagnostics by n times. With the help of MCA, [15-18] you can reduce the diagnostic time by n times, where n is the number of analyser inputs. The modelling algorithm is developed that allows to realize the diagnostic process of multi output digital devices based on the developed simulation model of MSA. The MSA simulation model is developed for the number of inputs of 4, 8 and 16.

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