ИКОНОМИКА И УПРАВЛЕНИЕ, ГОД. VI, №2

Гл. ас. д-р УЛЯНА ПАСКАЛЕВА
ЮГОЗАПАДЕН УНИВЕРСИТЕТ „Н. РИЛСКИ", Благоевград

ИЗМЕРВАНЕ И АВТОМАТИЗАЦИЯ

MEASUREMENT AND AUTOMATION

Chief Assistant Prof. PhD ULIANA PASKALEVA
SOUTH-WEST UNIVERSITY "N. RILSKI", Blagoevgrad

Abstract: The paper describes the conception for Intelligent Measurement Systems (IMS) and Virtual Instruments (VI) and now already wide used in practice.

Intelligent Measurement Systems (IMS) are created on the base of the computerizing techniques and in the process of measuring they use preliminary and current information as well as knowledge about the measurement saved in the system.

Virtual Instruments (VI) are a natural evolution of computer - based measurement systems and a consequence of the increasing of the computer hardware power and the new technique of programming. Very often used program environments are: Lab VIEW, DIA dem, Lab Window, but firms, correspondly National Instruments and s.o.

The means of environment are: graphic programming by graphical language G with functional blocks and VI, and s.o.

Key words: Intelligent Measurement Systems, virtual instruments, measuring devices, characteristics of errors..

1. INTRODUCTION:

The development of the measurement science in direction of wide use of computers, the complex objects under test and as consequence more complex measuring procedures have played an important role for creating of the so called intelligent measurement systems. IMS are instruments (systems for measurements), capable in the measuring procedure automatically to change its system structure, algorithm of acquisition and processing of measurement information with regard to rational use of the sources and achievement of the necessary level of metrological assurance [3, 6, 7].

IMS as a rule are created on the base of the means of computing techniques and during the measurement process use a-priory and current information, but also and knowledge that is stored in the system.

In the process of metrological and measurement technique development a great positive experience for determination of the error characteristics of the measurement results is obtained. In such a time there are know an essential number of methods for optimal inter examinational intervals of classical measuring tools [4, 6, 7].

The existing methods do not directly be used for metrological assurance of IMS (build on modern informational technologies). It is necessary to solve the tasks concerning estimation of the characteristics of the measurement results` errors for non fixed early unlimited sets measurement situations (including on the base of the data and knowledge organization, saved in the system) [1, 2].

Quite actual is the conception for Virtual Instrument (introduced in literature after 1990) and now already wide used in practice. This idea is a natural evolution of computer- based (integral) measurement systems and a consequence of the increasing of the computer hardware power and the new technique of programming. Lab VIEW (Laboratory Virtual Instruments Engineering Workbench) is a graphical programming language that uses icons instead of lines of text to create applications [5, 6, 7].

2. AUTOMATICALY DETERMINATION OF SOME METROLOGICAL CHARACTERISTICS

From formal metrology point of view and based on the analytical algorithmic description of measurement procedures, the error from the result of measurement with IMS, presented in a kind of full group constituents and stipulated by different factors, is as fallows:

$$(1)\quad \Delta\lambda^* = \Delta_{mp.}\lambda^* + \Delta_{np.}^{M}.\lambda^* + \Delta_{a}^{M}.\lambda^*$$

Where:

$\Delta_{mp.}\lambda^*$ is resulting transformed errors, stipulated by errors in measurement channels of IMS and errors of parameters of the algorithm for numerical processing of measurement information;

$\Delta_{np.}^{M}.\lambda^*$-error of the processor, stipulated by rounding in numerical measurement transformation;

$\Delta_{a}^{M}.\lambda^*$ - resulting algorithmic error, stipulated by the possible approximation of measurement algorithm.

Very often the result of numerical treatment of the measurement information (in particular the final result of measurement) can be presented in a kind of:

$$(2)\quad \lambda^* = f\left(x_1^*, x_2^*, \ldots x_n^*\right),$$

Were:

$x_1^* = x_1 + \Delta x_1^*$,

$x_2^* = x_2 + \Delta x^*, \ldots\ldots, x_n^* = x_n + \Delta x_n^*$ are results in intermediate measurements in the outputs of measurement channels and parameters of the algorithm containing errors. It should be of interest to consider the maximal border of the error from the results at numerical measurement transformations in IMS. It is one of the methods that are in the foundation of the errors characteristics of the results in numerical measurement transformations in IMS (as a procedure of third level). The procedures (broken down in 3 levels) of the metrological automatic assurance are shown in Table 1.

The finite point method does not require open analytical giving of the transform function and because it is a differencing function and has limited private derivatives for all the region of its arguments, but the error of the measurement result add misses linearization for arbitrary point $x^* = \left(x_1^*, x_2^*, \ldots, x_n^*\right)$:

$$(3)\quad \Delta\lambda^* = \lambda^* - \lambda \cong \sum_{i=1}^{n} \frac{df\left(x^*\right)}{dx_i} \Delta x_i^*$$

Then the task for finding of maximal value of the error $\Delta\lambda^*$ can be formulated as an optimization task:

.

(4)

$$\left\{ \begin{array}{c} \Delta_p \lambda^* = \arg\max \left| \sum_{i=1}^{n} \frac{df\left(x^*\right)}{dx_i} . \Delta x_i^* \right| \\ \left| \Delta x_i^* \right| \le \Delta_p x_i^*, i = 1, \ldots . n \end{array} \right\}$$

The points of its solution in accordance with the well known theorem of linear programming for maximum and minimum of a linear function (with more special qualities), still can be presented, as the largest are an estimation of maximal limit of measurement result errors.

Table. 1

Level	Function of the procedure	Input data	Output data
	Estimation of the characteristics of the measurement devices' errors in real work conditions	Specification of devices (metrological characteristics of devices, work conditions, input signal properties)- $x_i\|t\|$	Characteristics of the dvices errors in real work conditions
II	Definition of the characteristics of the errors of intermediate measurements at the outputs of measurement channels $\theta(\Delta x_i^*)$	Structure of the measurement channels, characteristics of the devices errors, transform functions of the measurement channels (MC)	Characteristics of the errors of intermediate measurement results at the outputs of MC- $\theta(\Delta x_i^*)$
III	Definition of the characteristics of the final result of measurement- $[\theta(\Delta\lambda_i^*)]$, by reporting of multidimentional algorithms while digital signal processing	Characteristics of the MC errors, structure of the multi channel procedure of measurement, specification of the multidimensional digital data processing algorithm	Characteristics of the errors of final result of measurement

3. VIRTUAL INSTRUMENTS AND APPLICATION.

Lab VIEW (Laboratory Virtual Instruments Engineering Workbench) is a graphical programming language that uses icons instead of lines of text to create applications. In contrast to text-based programming languages, where instructions determine the order of program execution, Lab VIEW uses dataflow programming, where the flow of data through the nodes on the block diagram determines the execution order of the VIs and functions.

VIs or Virtual Instruments (VIs) are Lab VIEW programs that imitate physical instruments.

A VIs contains the following three components:

- **Front Panel –** serves as the user interfase.

- **Block Diagram –** contains the grafical sourse code that defines the functionality of the Vis.

- **Icon and connector pane –** identifies the interfase to the Vis so that we can use VI in another VI.

Figure 1. Front Panel

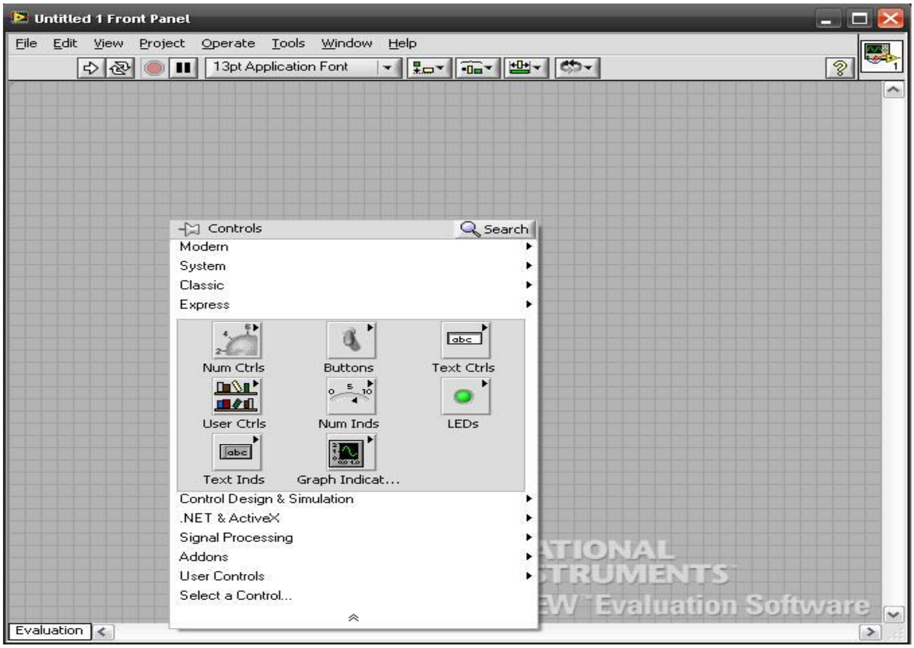


Figure 2. An example of a front panel

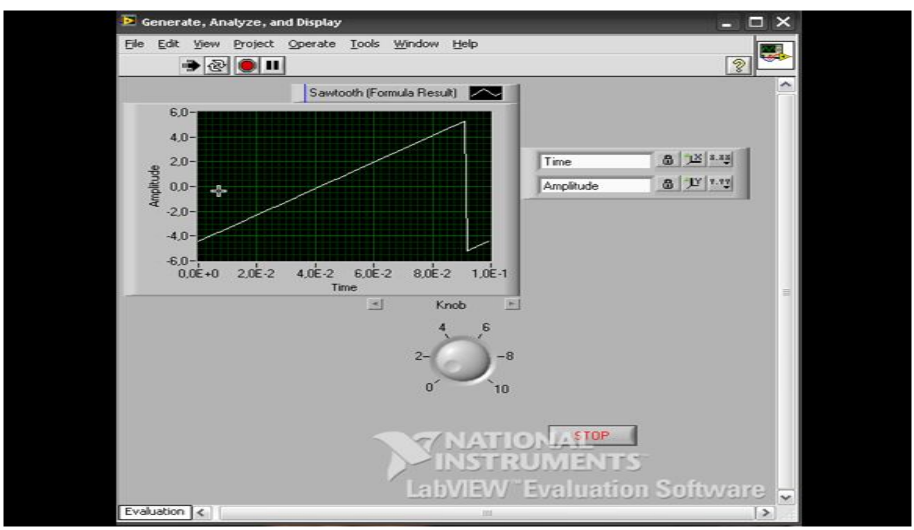


Figure 3. Block Diagram

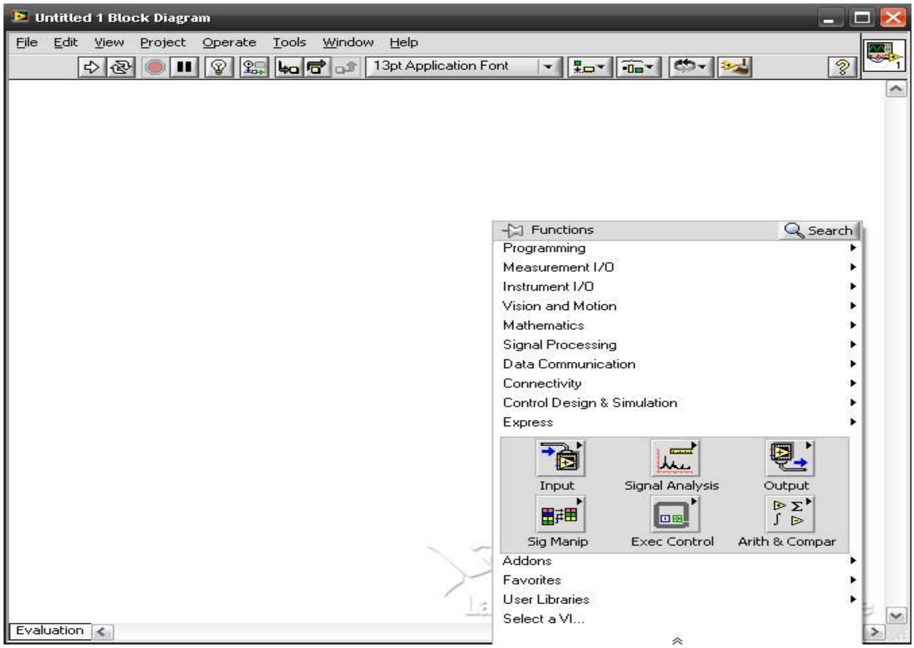
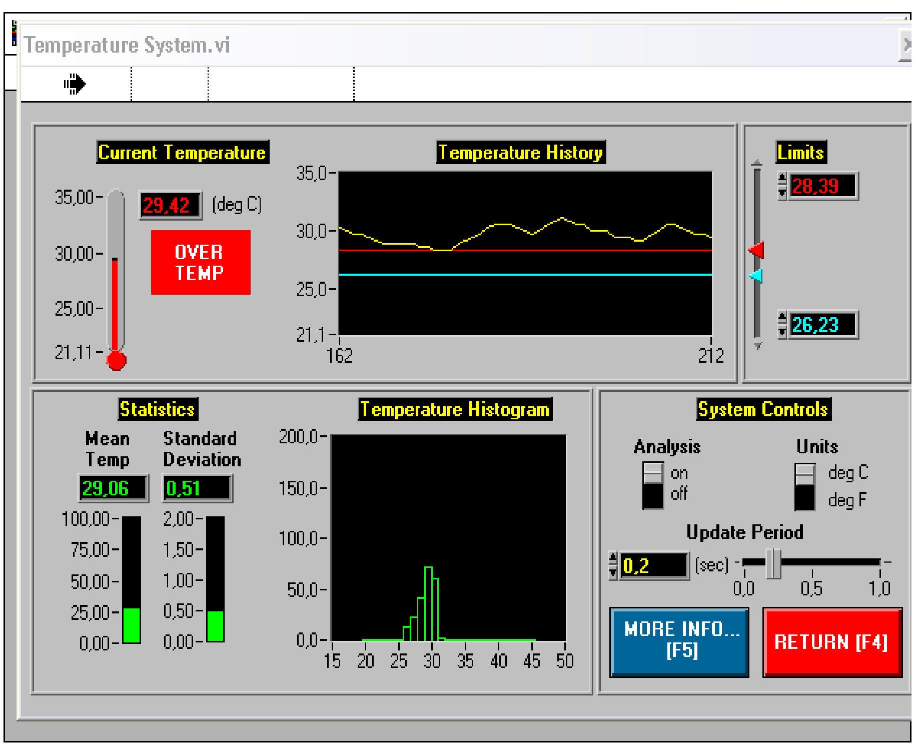


Figure 4. Application: Temperature System (VI)



3. CONCLUSIONS

The procedures (broken down in 3 levels) of the metrological automatic assurance are shown in Tab.1.

For this aim “measurement knowledge” is used, i.e.: mathematical models of the objects, input measurement signals and instrumentation, algorithmic assurance of metrological analysis, but also and additional information from auxiliary measurements - for example the characteristics of external conditions.

Nowadays it is necessary to carry out a metrology assurance of classical instrumentation (non-including in its structure microprocessors, microcontrollers that can not be included in microprocessor measurement system). With respect to assurance of there’s precision and good metrological characteristics it is still of vital importance the interchecking intervals (the time between 2 checks) [1, 2, 3, 6].

Quite actual is the conception for virtual instrument (introduced in literature after 1990) and now already wide used in practice.

This idea is a natural evolution of computer- based (integral) measurement systems and a consequence of the increasing of the computer hardware power and the new technique of programming. Very often used program environments are: Lab VIEW, DIA dem, HPVEE, Lab Window, S/CVI, but firms, correspondly National Instruments, Gesellschaft fur Strukturanali se, Aachem Hewlett – Packard [5, 7]. The means of environment are: graphic programming by graphical language G with functional blocks and VIS, and s.o.

REFERENCES:

[1]. Kalchev I., “Control and self diagnosis in μ p-based measurement systems”, Second Intern. Symp. on Measurement Technology and Intelligent Instruments, Chongqing-Wuhan, China,1993

[2]. Kalchev I., “Metrological analysis as measurement errors in instrument transducers”, Joint Conference: IEEE INSTRUMENTATION AND MEASUREMENT TECHOLOGY-IMEKO, Proc. Vol.,p.p.1232-1236, Published by IEEE INSTRUMENTATION AND MEASUREMENT Society,U.S.A.

[3]. Kalchev Ivan D., Paskaleva Uliana,” Aspects of Metrological Assurance of the Intelligent Measurement Systems”, International Scientific Conference “Mathematics and Natural Sciences” Souht - West University „ N. Rilsky”, Blagoevgrad, 2005 – Volume 1, p.185-189, ISBN 954-680-352-9.

[4]. Paskaleva Ul., Petrov N., “Correction Algorithm of work of the Intelligent Measurement Systems in statical and dynamical control”, Jurnal “Bulletin”, Technical University – Sofia, office Sliven, 1, 2008, pp 10-17, ISSN 1312-3920.

[5]. Paskaleva Ul., Georgieva Iv., “Virtual Instruments and Apllication”, Collection of science research reports “Novelty in the Technologys 2008”, Technical Koleg, South - West University „ N. Rilsky”, Blagoevgrad, pp 37-43, ISBN 978-954-680-570-6.

[6]. Sobolev, Vladimir S., “Metrologicheskoe avtosoprovojdenie rezultatov izmerenii v intelektualnih izmeriteljnih sistemah”, pp. 8-18, auto-pepar on dissertation, Sankt-Peterburg, 1999.

[7]. http://www. ni. com/.