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Virtual Quality Analyzers of Industrial Production

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ABSTRACT*:* Considered the problem of virtual Analyzer of commodity flows, designed to study and visualize the results of monitoring the quality of raw materials entering the technology installation. Virtual Analyzer is designed as a software system that responds to analytical queries on current change duty properties of raw materials, the accuracy of the reported analyses and expected changes its properties.

KEYWORDS*:* virtual analyzers, quality monitoring, technical implementation, decision support, hardware technical means.

I. INTRODUCTION

Modern systems operational management of industrial production is characterized by the widespread introduction of information technology focused primarily on the collection and storage of information technology, reflecting the change of state of the process. High-performance monitoring systems allow you to collect and store vast amounts of multidimensional interrelated data, which contain valuable production experience. However, the direct use of the accumulated information involves significant difficulties due to the limited possibilities of the human brain for processing digital multiparameter data sets. Direct visualization of these data, which facilitates their perception, is limited by the possibility of a two-dimensional projection. In this regard, there is an urgent need to develop analytical information technologies for deep mathematical processing of large volumes of data and multiparameter mapping results to the substantive interpretation of the plane (ie, in a form accessible and direct user - technologist, chief plant operator etc.).

Analytical information technology designed to resolve contradictions:

- Between the huge volume of data sets generated in the process of monitoring the status of the process, and the ability of the human brain in their perception and analog (qualitative) processing in the interest of generating control technology solutions ;
- Between the capabilities of modern applied (computer) Mathematics and the extremely low level of its application for the benefit of quantitative analysis of the production situation and automated drafting process controls.

It should be noted that the technical implementation of automated analytics can be performed in a variety of shapes and sizes - from analytical centers of strategic management to local industrial enterprise software systems, used as a virtual process analyzers [1]. However, these systems provide ideologically identical decision problems - extracting from the set of retrospective and current data obtained during the monitoring of the state of production, additional knowledge, reflecting trends and relationship management objects. In other words, a virtual analyzer should be considered as a functional element of a decision support system designed to increase the efficiency generated by technological controls, and, as a consequence of the industrial production.

II. CONCEPTUAL BASES FOR VIRTUAL ANALYZERS

Conceptual bases for virtual analyzers and their applications in condition monitoring and control technology were described in detail in [2].

Results of analyzes of the feed streams are essential information is largely determined by the further process of object management. However, the quality of these analyzes, in developing indicators such as completeness, reliability and

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efficiency, as a rule, are not sufficient.

In particular, the accuracy of the test results obtained by means of industrial laboratories, is largely determined by the human factor (laboratory experience and integrity), features a sampling state laboratory equipment etc. Low throughput laboratories, combined with the relative high cost of laboratory tests lead to the forced restrictions on the completeness of the analysis. And, perhaps, the weakest link of laboratory tests is their extremely low efficiency.

Application of online analyzers significantly increases the efficiency of material flow control condition, however, the cost of these devices is very high. In this regard, the possibility of equipping production such devices is very limited, which inevitably affects the completeness of monitoring. In addition, most on-line analyzer requires highly regular (and therefore expensive) maintenance.

III. VIRTUAL DATA ANALYSIS

In this connection there is an alternative approach to solving the problem of improving the monitoring of the feed streams, based on the principles of virtual data analysis.

We shall distinguish two main (generally related) virtual function analyzer feed streams (raw stream analyzer, RSA): production and research.

Production function reduces to:

- visualizing the current state of the feed stream deflection state of said secondary flow characteristics for the selected time interval as well as the condition for a time corresponding to the prior laboratory analysis;
- identification of erroneous rejection (inaccurate) analyzes;
- short-term forecasting of the state of the feed stream to form a proactive management;
- indirect monitoring of test and measurement equipment.

RSA function research is to study the dynamic and static characteristics of the historical data (stored in the database) in order to increase the efficiency of process management based on the detection and analysis of influence factors, latent tendencies of development, technological linkages and external (exogenous) parameters.

Functional structure analyzer feed streams, shown in Figure 1, reflects the basic operations implemented program RSA.

Substantive information (laboratory tests raw material parameters) enters the database as a temporal sequence of multidimensional data. The data accumulated in the database to form a two-dimensional table of size <N:M>, where N - number of vector of observations (number of rows), M - amount of raw parameters (number of columns). The data contained in the original database does not fully meet the requirements of a data processing system. In this regard, the primary functionality of RSA is a subsystem of input and pre-processing of data, including the program of choice and formation of working arrays.

The main functionality of RSA is to visualize the properties of the feed streams, their description and prediction in view of possible anomalies and inconsistencies observations.

Transition to intellectualize embodiment virtual analyzer assumes the second stage of development, providing the addition block structure presented automated interpretation of the analysis results [3].

The structure of this block is shown in Fig. 2 and includes a knowledge base and an interpreter analyzes of the feed streams. When this is built in the form of an add- on knowledge base which allows to combine heterogeneous data management capabilities - numeric and text. In text format presented meaningful descriptive information relating to the various production situations

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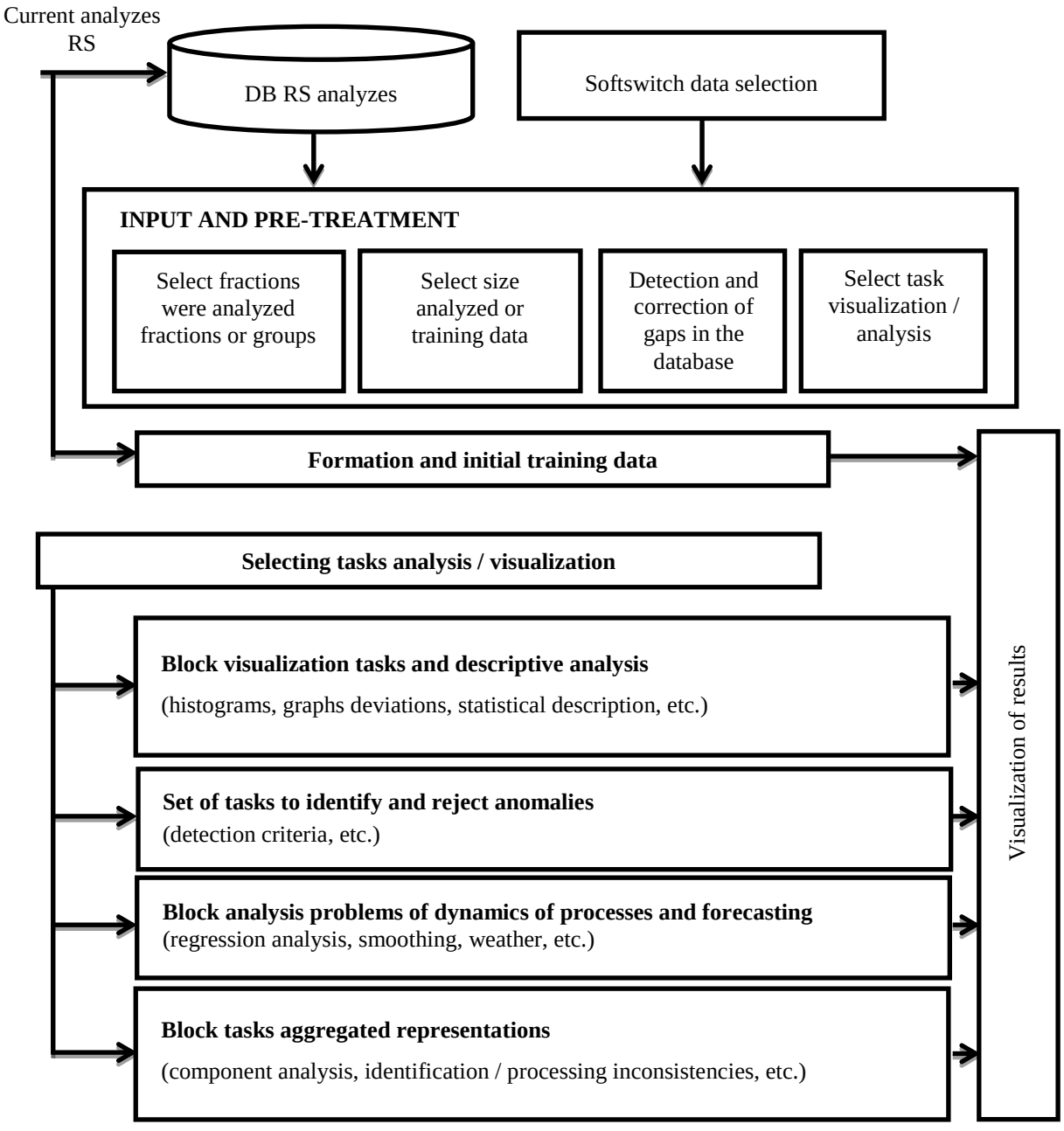

Fig.1. Functional structure analyzer feed streams.

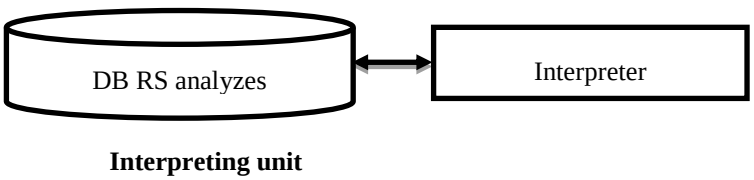

Fig. 2. Simplified functional block structure interpretation of the results of the virtual analyzer.

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Block diagram of the program analyzer virtual commodity flows is shown in Fig. 3.

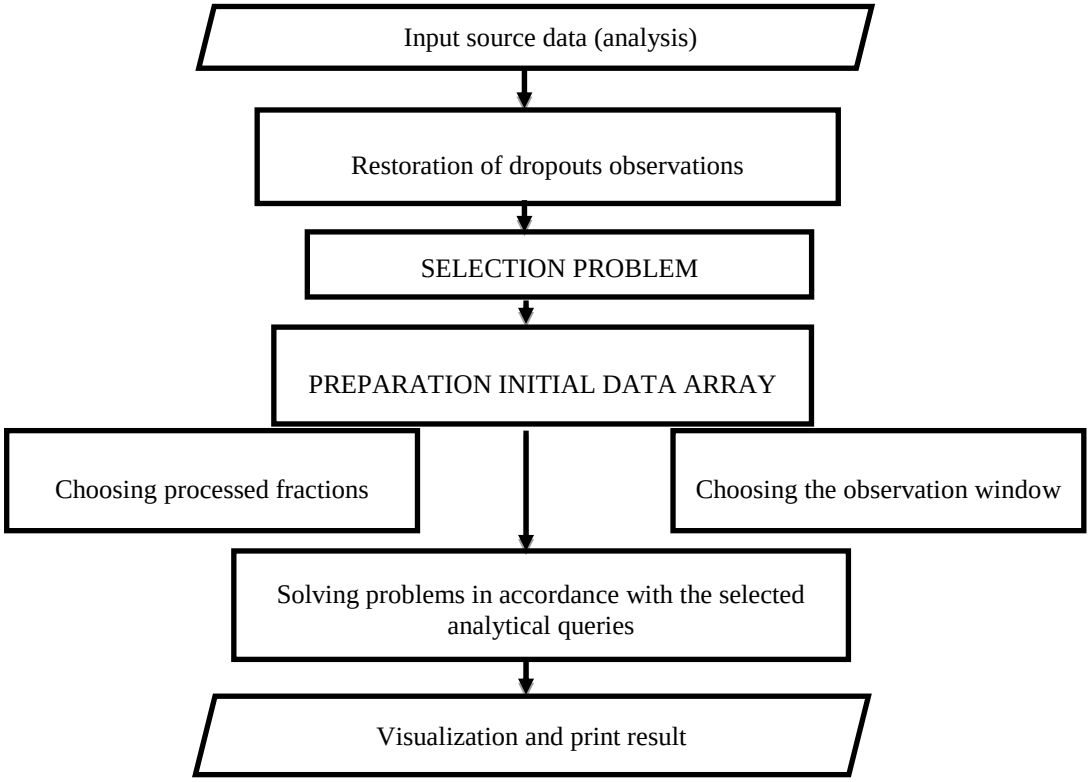

Fig. 3. Structural diagram of the program analyzer virtual commodity flows

IV. USING VIRTUAL ANALYZERS

Development of the technology of virtual instruments (VI) is closely linked with the development of the computer industry. Over the last decade, microprocessors and software methods are becoming more and more powerful. The development of industrial standards to ensure compatibility of peripherals and interfaces are VI on the basis of computers, is the second prerequisite for widespread use of the VI. Introducing a new generation of instrumentation branch, having VI perspective for use in academic institutions, research centers, in the areas of manufacturing, automotive, medicine and Biomedicine.

The VI is computer software designed for testing, measurement and process control purposes. Connecting standard hardware computer interfaces (such as information-gathering systems, RS 232 and IEEE-488) with the processing power of the CPU unit VI function is defined by software.

VI may implement various tests and measurement functions, including:

1) management information flow from peripheral devices (such as sensors and signal processing circuits) through a standard interface with the CPU;

2) graphical representation and analysis of the data collected;

3) data management, archiving, printing type access from Internet or local network, etc.

Compared to traditional measuring instruments based on hardware technical means, the main advantage of the VI is its flexibility, which is of great importance in public research. The functionality and user interface (UI) defined by the manufacturer. For comparison, the functionality VI may be explicitly defined, modified and expanded its users through software. Once installed, the VI platform, clients can determine the functionality you need, customize the user interface for yourself and modify the functionality VI whenever necessary.

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The effectiveness of the VI is largely determined by the friendly user interface programming. Instead of text-based programming languages, where the syntax and punctuation are important moments, language for programming VI is based on the chart. Graphic images, rollover text commands, simply connect with others through the lines. Icon set determines the measurement and analysis functions. Graphical user interface (GUI) is a clear, logical and visually appealing a summary overview of the interior work complete program; simplifies the development of programs, documentation, and maintenance and servicing, as well as reduces the number of programming errors.
Since VI is based on a computer, its functional abilities are limited by the hardware features of your computer: processor performance, structure and system bus bandwidth, i/o interfaces, configuration, etc.

V. CONCLUSION

Solving problems on arrays of operational and historical information, are selected by means of analytical queries, provided a set of procedures imple forming various data mining algorithms (Data Mining).
Thus, we consider the problem of constructing a virtual commodity flow analyzer, designed for research and visualization of the results of monitoring the quality of the raw material supplied to the processing unit. Virtual Analyzer is designed as a software system that responds to analytical queries duty shift relative to the current properties of raw materials, reliability of the analyzes and the expected changes in its properties.

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