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ALGORITHMS AND CIRCUITRY METHODS FOR INCREASING THE NOISE IMMUNITY OF ANALOG BLOCKS OF INFORMATION-MEASURING SYSTEMS

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Abstract:

This article deals with algorithms and electronic methods to increase the immunity of analog blocks of information measurement systems to noise. However, the author not only discusses the algorithm in detail, but also provides detailed information about the analog blocks. The main requirements for an intelligent measuring channel are considered in the article when designing automated control and control systems. The methods for estimating errors are classified and the constituent groups are classified, and some methods for calculating the errors of measuring means and measuring modules of automatic control systems are given

Keywords: System; error; correction; predictive model; genetic algorithm; anolog; blocks; information-measuring systems.☐

The concept of algorithm has existed since antiquity. Arithmetic algorithms, such as a division algorithm, was used by ancient Babylonian mathematicians c. 2500 BC and Egyptian mathematicians c. 1550 BC. Greek mathematicians later used algorithms in 240 BC in the sieve of Eratosthenes for finding prime numbers, and the Euclidean algorithm for finding the greatest common divisor of two numbers. Arabic mathematicians such as al-Kindi in the 9th century used cryptographic algorithms for code-breaking, based on frequency analysis. The word algorithm itself is derived from the name of the 9th-century mathematician Muḥammad ibn Mūsā al-Khwārizmī, whose nisba (identifying him as from Khwarazm) was Latinized as Algoritmi.

Metrological characteristics of information-measuring systems (IMS) are determined from the combination of characteristics of the elements of the measuring channel. IMS tools with various functionalities and hardware implementations are combined with an identical structure, which differs only in the specific performance of individual devices. The main functional units included in the IMS are: measuring systems (amplifier, MS, ADC), computing part (microprocessor, RAM, ROM), auxiliary part (power supply, input-output devices). A characteristic feature of instruments measuring parameters of moving objects is their operation in dynamic conditions. They are caused by motion of moving objects, shaking of ships, fluctuations of aircraft and vehicles, as well as by vibrations taking place in the location of the measuring instruments. Those motions generate inertial forces and moments which act upon the measuring instruments and systems causing a dynamic error in the measurement result. If there are no appropriate solutions in the metrological chains and procedures of the measuring instruments to deal with the problem, the dynamic error could be considerable, which leads to a high inaccuracy of the measurement result. Another important feature of the metrological problems to be solved in these cases is that the measured quantities and the interference effects are characterized with parameters (intensity and frequency of the maximum in the spectrum) that are changing within a wide range. It is a serious obstacle in the synthesis of measuring instruments that provide an acceptable measurement accuracy for the wide range of changing the parameters of the inertial effects.

This problem could be solved by using adaptive algorithms integrated in the metrological chain of measuring systems. The mathematical models of those algorithms can be developed so as to make possible the automatic adjustment of their parameters depending on the current state of measurement conditions. In addition, the structure, parameters and measurement procedures of those algorithms can be developed in such a way that any parameter accepted as a measure of divergence between the measurement result and the measured quantity can have a function minimum for given measurement conditions. One of such parameters can

In mathematics and computer science, an algorithm (/ˈælɡərɪðəm/ (About this soundlisten)) is a finite sequence of well-defined, computer-implementable instructions, typically to solve a class of problems or to perform a computation. Algorithms are always unambiguous and are used as specifications for performing calculations, data processing, automated reasoning, and other tasks.As an effective method, an algorithm can be expressed within a finite amount of space and time, and in a well-defined formal language for calculating a function. Starting from an initial state and initial input (perhaps empty), the instructions describe a computation that, when executed, proceeds through a finite number of well-defined successive states, eventually producing "output" and terminating at a final ending state. The transition from one state to the next is not necessarily deterministic; some algorithms, known as randomized algorithms, incorporate random input.

It is frequently important to know how much of a particular resource (such as time or storage) is theoretically required for a given algorithm. Methods have been developed for the analysis of algorithms to obtain such quantitative answers (estimates); for example, the sorting algorithm above has a time requirement of O(n), using the big O notation with n as the length of the list. At all times the algorithm only needs to remember two values: the largest number found so far, and its current position in the input list. Therefore, it is said to have a space requirement of O(1), if the space required to store the input numbers is not counted, or O(n) if it is counted.

The analysis, and study of algorithms is a discipline of computer science, and is often practiced abstractly without the use of a specific programming language or implementation. In this sense, algorithm analysis resembles other mathematical disciplines in that it focuses on the underlying properties of the algorithm and not on the specifics of any particular implementation. Usually pseudocode is used for analysis as it is the simplest and most general representation. However, ultimately, most algorithms are usually implemented on particular hardware/software platforms and their algorithmic efficiency is eventually put to the test using real code. For the solution of a "one off" problem, the efficiency of a particular algorithm may not have significant consequences (unless n is extremely large) but for algorithms designed for fast interactive, commercial or long life scientific usage it may be critical. Scaling from small n to large n frequently exposes inefficient algorithms that are otherwise benign.

To illustrate the potential improvements possible even in well-established algorithms, a recent significant innovation, relating to FFT algorithms (used heavily in the field of image processing), can decrease processing time up to 1,000 times for applications like medical imaging. In general, speed improvements depend on special properties of the problem, which are very common in practical applications. Speedups of this magnitude enable computing devices that make extensive use of image processing (like digital cameras and medical equipment) to consume less power. The analogue instrument is defined as the instrument whose output is the continuous function of time, and they have a constant relation to the input. The physicals quantity like voltage, current, power and energy are measured through the analogue instruments. Most of the analogue instrument use pointer or dial for indicating the magnitude of the measured quantity.

Development trends of devices for an analog input of information determine the following structure of the measuring channel. A physical quantity (PQ) is converted by a primary measuring transducer (PMT) into current or voltage, then this signal is amplified by a unifying transducer (UT), to transmit this signal to the ADC inputs. Analog filters (AF) are usually installed before the ADC. After the ADC, information signals in digital form are processed by a microprocessor (MP). The results of the measured parameter are transmitted via the interface channel to the control and control systems(CS).Thus, one of the most significant factors limiting the accuracy of a measuring device (MD) at a low level of the output signal of the conversion circuit is the effect of the intrinsic noise of the primary converter(PC), which is related to thermal noise and is due to the presence of a signal equivalent to internal resistance R3 as a source of signal (resistance of the mass of liquid between the electrodes). This noise arises in any circuit having an equivalent active resistance, and its value depends only on the resistance value and does not depend on the physical nature of the noise source. The spectral density of thermal noise is frequency independent. The noise of the operational amplifier is characterized by noise voltages and currents reduced to the input and having a power spectral density of $sU(\omega)$и $s(\omega)$, respectively.

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