RADIO MEASUREMENTS

THEORETICAL PRINCIPLES OF THE CONSTRUCTION OF FUTURE TELEMETRY SYSTEMS AND FOR ACQUIRING AND PROCESSING TELEMETRIC DATA

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Principles for constructing future telemetry systems for gathering and processing telemetric data are considered. The principles are based on fundamental investigations of telemetric data transmission using homomorphous images.

The future development of such methods of measurement as telemetry and the use of computer calculation techniques assumes that new mathematical apparatus will be developed. The requirement in this connection involves primarily basically new possibilities for microprocessor computer technique, its wide introduction into on-board systems, and the need to set up computer networks to acquire and process telemetric data.

In this connection, particular attention is being given to methods of computer algebra [1, 2]. Some examples of its use for transmitting telemetric data were considered in [3]. However, modern requirements require systems for measuring and transmitting data and for carrying out calculations to have an organic unity. It is possible to satisfy these requirements using single formalized representation, for which one can use polynomials, which formally describe the sequence of transmitted and processed data, and also a polynomial-remainders of its algebraic division by chosen polynomial moduli. Here, for example, one can set up a distributed (multidimensional) data transmission and processing system, in which the information messages determine the coefficients of new polynomial-remainders. This also turns out to have a positive effect on the computing process, including symbol calculations.

From the point of view of mathematical definitions, this approach indicates an orientation during transmission and calculations, not towards the traditional representation of data, but to their homomorphous representation, which, in particular, the remainders of a division are.

Existing solutions of problems in this formulation [1, 2] have been combined with considerable difficulty due mainly to the need to recover the transmitted data and the results of calculations in traditional form (initial-data regions), the basis of which are remainder theorems.

Remainder theorems have a set of application in symbol (analytic) calculations, connected with the use of polynomial arithmetic. Their area of application is extremely diverse: from the solution of systems of polynomial equations and effective calculations in factor-rings and algebraic expansions to data coding theory and the synthesis of superfast discrete Fourier transform algorithms [1-3]. We know [1], that finite fields $F$, by analogy with fields from a ring of integers, can also be constructed from rings of polynomials $R$. By choosing an arbitrary polynomial $m_i(x)$ from $R$ we can determine the ring of ratios $R/m_i(x)$, using $m_i(x)$ as the modulus for specifying the arithmetic of this ring. In other words, we can change to the same structure of the formal representation of a comparison as in the case of a ring of ratios of integers $Z/m_1$:

$$x \equiv b_i (\text{mod} m_i), 
\begin{align*}
    x, b_i, m_i & \in \mathbb{Z}; \\
    f(x) & \equiv b_i (\text{mod} m_i(x)), 
    \{f(x), b_i(x), m_i(x) \in R\}
\end{align*}
$$

Here the coefficients $\beta_i$ of the polynomial-remainder $b_i(x) = \beta_{k-1}x^{k-1} + \ldots + \beta_0$ can be represented both in the ring $\mathbb{Z}$ ($\beta_i \in \mathbb{Z}$) and in the Galois field $GF(p)$ ($\beta_i \in GF(p)$). These two situations can be formally denoted by $R = \mathbb{Z}[x]$ and $R = GF(p)[x]$. In the latter case, representation (I) is understood as the average of the binary modulus $(m_i(x), p)$ and can be written as follows:

$$f(x) \equiv b_i(x) \pmod{m_i(x), p}.$$

We will discuss in some detail the formal apparatus for recovering polynomials from their remainder on the basis of the following constructive theorem of residues.

**Theorem.** Suppose we are given a ring of ratios of polynomials $R/I$, where $I = (m_i(x))$ is an ideal in the form of the following homomorphism: $R/I \rightarrow R/m_i(x) \oplus R/m_2(x)$, which leads to the comparison system $f(x) \equiv b_i(x) \pmod{m_i(x)}$, where $i = 1, 2, \ldots$. Then, its unique solution will be the polynomial $f(x)$ which defines one of the conditions listed below taking the divisibility into account: $n_{12}(x)/n_{12}(x)$, where $n_{12}(x) = f(x) - b_i(x)$, $n_{12}(x) = m_1(x) - m_2(x)$, $\deg m_1(x) < \deg m_2(x)$:

1) $m_2(x)(m_1(x) + A_{12}(x)) = 0$,
2) $m_2(x)(m_1(x) + A_{12}) = n_{12}(x)/n_{12}(x)$.

As follows from this analytical expression, the whole complexity of the recovery problem lies in establishing the fact of divisibility. We will consider one of the special methods for solving it. One of the methods of establishing the fact of the divisibility of $n_{12}(x)/k_0m_1(x)$ involves solving the following system of equations:

$$k_0 \gamma_1 + \mu_1 \gamma_0 = \lambda_1 \gamma_1;$$

$$k_0 \gamma_2 + \mu_2 \gamma_1 = \lambda_2 \gamma_1;$$

$$\vdots$$

$$k_0 \gamma_r + \mu_r \gamma_{r-1} = \lambda_r \gamma_{r-1}.$$