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N. Filippov

The Account, Measurement and Calculation with Reformation of Accuracy, Quantity of Codes and Speed on Numerical Systems from Geometrical Progressions

ABSTRACT

Reforming of numerical systems (NS) into several variants, received from initial geometrical progression (GP) by recurrently removing all their odd members is proposed. On their basis of these NS variants being further development of a multiplicate notation found by the author, counters, analog-digital converters and computers with the improved characteristics were designed.

In Works of 24-th and 27-th IWK TH Ilmenau a multiplicative number system (MNS), measuring and coding real one-dimension of numbers Z_x by the next meanings of the members geometrical progression (GP) multiplication of meanings of figures of their categories is given as:

$$Z_x \approx \pm Z_{\text{no}} C^{\pm i} = \pm Z_{\text{no}} C^{\pm \sum_{j=0}^m k_j a^j} = \text{sign}(Z_x) |Z_{\text{no}}| \prod_{j=0}^m C^{\text{sign}(i) |k_j a^j|}, \quad (1)$$

where Z_x is meaning of parameter Z ; C is a denominator of geometrical progression (GP) depending of the maximum relative error δ_{max} ($C = (100 + |\delta_{\text{max}}|) / (100 - |\delta_{\text{max}}|)$); $i = \pm 0, 1, 2, \dots$ are of the GP member numbers. They also at logarithmining Z_x on the basis C are the integer logarithms (IL); $Z_{\text{no}} = C^0$ is the zero GP member with dimension Z ; a is quantity of used figures; $j = \pm 0, 1, 2, \dots$ is number position; $k_j \in \{0, 1, 2, \dots, (a-1)\}$ is j category figure; m - is high-order position; $\pm \sum_{j=0}^m k_j a^j$ is an additive number system (ANS).

Since GP, IL, and ANS are organically connected in MNS, they were named by me numerical system (NS).

If ANSes have exponentially vanishing relative error from infinity up to zero on a coding range with Z_x fixed point representation value increase, and floating point representation saw-like form,

then GR and MNS provide constancy over all δ_{\max} coding range and code number breakeven. This property is useful and for devices, addressed to perception of their products functioning by human bioreceptors, as the work of the last obeys GP according to the law Weber-Fechners. Hence, if there is time functions discretization it is the sample law of their meanings in time submits to the Kotelnikov's theorem, the impotence of which is marked by Eduard Rhein's premium, then the temporary function meaning sampling, i.e. their quantization, should be carried out according to GP. It is important for digital telephony, digital TV, and digital photo. The increase of speed of measurements and calculations concerning the same operations, carried out on AP, is reached by various codes quantity reduction on the same ranges, and for calculations it increases also by their realization on IL.

$$\text{From GP } \langle \dots C_1^{-2}, C_1^{-1}, C_1^0 = 1, C_1^{+1}, C_1^{+2}, \dots, C_1^{+(i-1)}, C_1^{+i}, C_1^{+(i+1)}, \dots \rangle \quad (2)$$

the second number scale ensuring smaller accuracy, but more economy and speed, is a train derivable from (2) by removing all their odd GP members:

$$\langle \dots C_1^{-2} = C_2^{-1}, C_1^0 = C_2^0 = 1, C_1^{+2} = C_2^{+1}, C_1^{+4} = C_2^{+2}, \dots, C_1^{+(i-2)} = C_2^{+(i-1)}, \\ C_1^{+i} = C_2^{+i}, C_1^{+(i+2)} = C_2^{+(i+1)}, \dots \rangle.$$

The identical removal of all odd members in the last train will give the third numerical system with $C_3 = C_2^2 = C_1^4$. Reference meanings of the Zoi GP members for Zni data are defined by expression $Zoi = Z_{\Pi} 100 / (100 + |\delta_{\max}|) = Z_{\Pi} - Z_{\Pi, i-1}$.

The computer for fast determination of parameters quality of any devices are designed on numerical scales, derived by thinning GP members train (2).

The computer on NS are built by five methods: programmed; on IL – of multiplication and division, on IL from IL – of extraction of roots and erection in a degree with real parameters, and addition and subtraction by usual adders; completely on IL; with described re-formation on several NS; computer operating by reading results previously written down in its memory ready results of single and double operations which are general problems parts.

The advantages GP are realized more fully by light (Gerd.Jäger) and holography.

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