

THE DINAMICS OF A TWO-DIMENSIONAL RECURSIVE DIGITAL FILTER OF THE SECOND ORDER AT TWO-LEVEL QUANTIZATION*

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The two-dimensional digital second order recursive filter with non-linearity of the adder of a type saturation and two-level quantization featured by a difference equation of a view is explored:

$$X(m, n) = f\{a[X(m-1, n) + X(m-2, n-1)] + b[X(m, n-1) + X(m-1, n-2)] + c[X(M-1, N-1) + X(M-2, N-2)]\},$$

where a , b and c - independent coefficients of the filter, and function $F(x)$ takes into account nonlinear properties of the filter, and its view depends on a choice of the characteristic of the adder and quantity of quantizing levels.

It is necessary to take into account that the complexity of one-dimensional nonlinear systems is not compared to complexity two-dimensional. Even because any terminal conditions for a two-dimensional system of the second order represents two infinite-dimensional in two directions vectors, whereas for an one-dimensional first order system the initial conditions is one sample. So to touch the every possible initial condition for a two-dimensional system becomes unreal at it's probing. For the analysis of an output signal by a size $L \times L$ of counting, it is necessary to sort out 2 in a degree $4(L+1)$ initial conditions, whereas for a filter of the first order them 2 in a degree $(2L+1)$, and for an one-dimensional first order system the initial condition in general is one sample. Therefore main attention is given to research of signals on an output at absence of entry effect and initial conditions such, that distinct from zero are only a few counting, and all remaining are peer to zero. But already exploring a system at such terminal conditions it appears, that some results remain valid and at other initial conditions.

In the system it is revealed of more hundred various signals, possible on an output of the system. For each signal the conditions of coefficients of a two-dimensional recursive digital filter are imposed, necessary for his reaching are retrieved. The bifurcation portraits of the system at various types of the initial conditions are constructed. Is parsed of the speaker of an output signal at offset of the single initial condition on vectors $X(-2, m)$, $X(-1, m)$, $X(-2, n)$, $X(-1, n)$ and exhaustive search of all possible initial conditions in quadrate $X(-2, -2)$, $X(-2, -1)$, $X(-1, -2)$ and $X(-1, -1)$.

In operation the theme of nonlinear effects in two-dimensional recursive digital filters of the second order with binary quantization was affected. The given problem is insufficiently investigated, and represents major interest for research. The mechanism of creation of an output signal of a various type is circumscribed depending on sort of the initial conditions. Some outcomes of operation can be generalized on a case of the initial conditions and level of quantization of arbitrary sort. The equations of planes dividing space of coefficients of a two-dimensional recursive digital filter are analytically retrieved.

The knowledge of nonlinear effects can help in design and use of digital filters and also in making on the basis of digital systems of oscillators of different motions. The analytical expressions for areas of existence of different types of motions, dissection of spaces of parameters into the relevant areas was obtained. The results of the investigations can be used for the further investigation and development of digital systems with quantization.



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