COMPUTING ALGORITHM OF MAIN DSP TYPES BASED ON CYCLIC CONVOLUTIONS

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With the development of computing facilities has extended simultaneously the application of the fast computation of class Fourier discrete transform (DFT). Many studies on FFT (fast Fourier transform) highlight the prospects of the further use of only valid calculations. In 1974 is proposed a discrete cosine transform (DCT), and in 1976 - discrete sine transform (DST), a valid basis of which reproduces functional in space or time dependences similar to the DFT. Cosine and discrete sine transform and Fourier transform are related by strict mathematical ratios that allows to find an effective way to compute one transform using the second. The DST has found wide application for a number of reasons. First, the basis functions of DST well approximate Karunen-Loyew conversion functions for a wide class of stationary casual processes, make it possible to describe the signal with a given accuracy with a minimum number of components. Secondly, DST contains a number of special properties and due to this fact gives good results when processing poorly correlated conversion signals, which leads to the taking into consideration of a significant signal energy. DST is used in many applications, especially in digital signal processing of audio and video. Further intensive development of information technologies puts higher requirements on the operation speed, functional and specific capabilities of algorithmic and hardware-software means of valid discrete transformations.

More than three decades of studies were dedicated to the efficient computation of one-and two-dimensional DST that were called as fast sine transform (FST). A considerable number of publications devoted to the efficient computation of DST were received.Multivariance of efficient computing are divided into algorithms with base two, cleft base, mixed base, unpaired volume, compound volume and the algorithm of simple multipliers.

For the synthesis of efficient DST the following approaches are used:

1) direct factorization of the DST matrix;

2) indirect computation using fast Fourier transform or the discrete Hartley transform;

3) algorithms based on complexity theory.

To obtain a fast algorithm generalized approaches based on polynomial transformations are used. It is shown that four types of DST have a group symmetry (that is, properties that relates to the theory of groups and their representations) and for each of them fast algorithm is calculated simply algebraically. New directions of efficient DST calculation, which are embodied in the form of specific algorithms are proposed. Works on the study of fast DST are generalized and systematized and final step in this direction is the theory of fast algorithms.

Calculation of DST and IDST (direct and inverse) are one of the most intensive and lengthy procedures in information technology, for example in the analysis and processing of image frames. That is, this procedure requires a maximum degree of enhancements that will accelerate the work of software and hardware. Among the directions of efficient algorithms is the possibility to calculate DST using cyclic convolutions. This direction of effective calculation uses the presence of fast convolution algorithms. Especially a lot of publications associated with computation common in DST applications via cyclic convolutions have appeared at the beginning of 90-ies.

Most studies use a transition from computing discrete conversion to cyclic convolutions, using reindexing of the simple volume according to Raider or the schedule of compound volume of transformation into simple multipliers after Agarwal and Cooley, or combining these approaches. The use of a computation method based on convolutions has its own characteristics to determine DST of different kinds analyzed in this work. Effective evaluation of each of the four types of DST can be performed based on the rearrangement of the elements of the input sequence with forming array followed by fast cyclic convolution algorithms. For DST I-III symmetric convolutions are done, and for the DST IV convolutions have the values of the arguments at two separate intervals from full period. The individual computation of cyclic convolutions, which have structured according to the given approach basis of the main types of DST, and the further integration of the obtained results allow effectively to carry out the evaluation process, reparalleling information processing.

The approach of efficient calculation of the four basic types of discrete sine transform (DST) based on cyclic convolutions is described. The options of forming array of the basic square matrix are used for the algorithm synthesis.

Keywords - discrete sine transform, forming array, algorithm synthesis, cyclic convolution.