ISSN 0735-2727, Radioelectronics and Communications Systems, 2010, Vol. 53, No. 3, pp. 167–172. © Allerton Press, Inc., 2010.
Original Russian Text © A.I. Rybin, Yu.Kh. Nizhebetskaya, 2010, published in Izv. Vyssh. Uchebn. Zaved., Radioelektron., 2010, Vol. 53, No. 3, pp. 58–64.

Analysis of Images Similarity and Difference Using Normal Orthogonal Conversion

A. I. Rybin and Yu. Kh. Nizhebetskaya
National Technical University of Ukraine "Kyiv Polytechnic Institute" (NTUU KPI), Kyiv, Ukraine
Received in final form November 5, 2009

Abstract—It is proposed a procedure of discrete orthogonal conversion, where the first transform coincides with reference signal. There are represented application of normal conversion for researched signals classification.

DOI: 10.3103/S0735272710030076

Estimation of signals (images) similarity and difference has great importance in solution of their classification (recognition) problem [1]. Among known methods of similarity estimation the simplest and spread are considered ones of matched filtering, but they proved their weak efficiency [2] for recognition of desired signal into a package of determined signals with different shape. Mentioned drawback in essential degree can be overcome using methods of normalization of discrete orthogonal conversions by step [3] and shape [4–6].

Advantage of normalization methods is spectrum of test signals transforms for normalized discrete orthogonal conversion contains only one non-zero transform. In case of distortions of test signal in transforms spectrum additional non-zero transforms appear, distortions degree can be estimated by means of transform factor [7].

A drawback of normalization by step method is its equidistant discretization step, moreover, two mentioned methods are non-applicable for calculation of linear system response in case of input signal normalization, both in counting number coordinates and in a region of corresponding conversion transforms [8, 9].

The methods' drawbacks can be eliminated by means of normalizing conversion application; the conversion is built for reference signal with arbitrary shape. Idea of normalizing conversion we illustrate using fourth order matrix operator. The matrix order is suitable due to idea's simplicity and clearness.

Let signal $x(t)$ is represented at a period by four equidistant samples

$$\overline{X} = [x_1, x_2, x_3, x_4]^{\mathrm{T}},$$

where "T" is transposition operator.

At first we form a matrix $\overline{\overline{W}}_1$ of discrete orthogonal conversion in following form

$$\overline{\overline{W}}_1 = \begin{bmatrix} x_1 & x_2 & 0 & 0 \\ -x_2 & x_1 & 0 & 0 \\ 0 & 0 & x_3 & x_4 \\ 0 & 0 & -x_4 & x_3 \end{bmatrix}.$$

A product of matrix $\overline{\overline{W}}_1$ and column-matrix $\overline{X}$ is thinned spectrum of the first conversion step

$$\overline{\overline{W}}_1 \overline{X} = \overline{X}_1 = [(x_1^2 + x_2^2), 0, (x_3^2 + x_4^2), 0]^{\mathrm{T}}.$$