# Edge Detection Based on Wavelets Constructed by Transforms of the Graph of Power Function

Marina Polyakova, Victor Krylov, Natalya Volkova

*Abstract* — **In this paper the method of construction of improved wavelets by transform of graph of power function is developed for the edge detection.**

*Keywords* — **Edge detection, Improved wavelets.**

In considerable part of computer recognition of visual patterns the objects of recognition have a hierarchical structure (object-subobject). For such problems or for the scene analysis it is necessary to distinguish objects on an image not only on the strength of edge but also on geometrical size of objects. In this case it is expedient to make edge detection of images in space of wavelet transform (WT) coefficients.

In this paper the noise stability of edge detection of images is increased and the error of determination of co-ordinates of position of objects edges on the different levels of hierarchy is lowered due to application of wavelets built by transforms of graph of power function. The method of construction of improved wavelets by transform of graph of power function is developed for the edge detection. The function graph is understood as a points set of a plane with rectangular co-ordinates $(x, y)$, where $y = f(x)$ is a real-valued function of one real variable $x$ which accepts values from a range of definition of this function [1] means of linear transforms of parallel shifting, scaling, and symmetry in some cases the function graph can be constructed with its parts or under a drawing of other function.

On the basis of the parallel shifting, scaling, and symmetry of graphs of power functions it is possible to formulate the method of construction of improved wavelets for the edge detection. It consists in the following.

1. To the graph of power function the left-shift on the positive value nonlinearly depending on a scale is applied. Such transform of the graph of power function allows constructing improved wavelets underlines the edges of objects of different geometrical size with a different error of determination of co-ordinates of position of edges.

2. The functions got at the previous stage of a method are scaled with the factor equal to value of a scale of transform. It ensures a possibility of processing of objects of different geometrical size with different noise stability.

3. Fragments of graphs of the got functions at $x$ <0 leave. The remained fragments of graphs are transformed by symmetry to axis *Oy*. The outcome of symmetry to axis *Oy* at $x$ <0 repeatedly is exposed to symmetry transform, but already concerning an axis *Ox*. Such transforms assume an equivalence of pixels of a line (column) of the image concerning a vertical (horizontal) axis.

The method of construction of wavelets by transforms of graph of power functions [1] applied on the wavelets

$$\psi_s(x) = \begin{cases} \dfrac{1}{s(x+1/s-1)}, & x>0, \\ \dfrac{1}{s(x-1/s+1)}, & x<0, \\ 0, & x=0. \end{cases}$$

Let's consider the case $\psi(x) = 1/x$. Let values of parameter of scale $s < 1$. The graph of hyperbola $y = 1/x$ (Fig. 1, a) we shift on $(1/s - 1) > 0$: $y_1 = 1/(x + 1/s - 1)$ (Fig. 1, b). From graph $y_1 = 1/(x+1/s-1)$ we leave a fragment at $x > 0$ to which we apply a scaling with factor $1/s$ (Fig. 1, c). We map antisymmetrically the resulted graph on negative semiaxis *Ox* (Fig. 1, d).

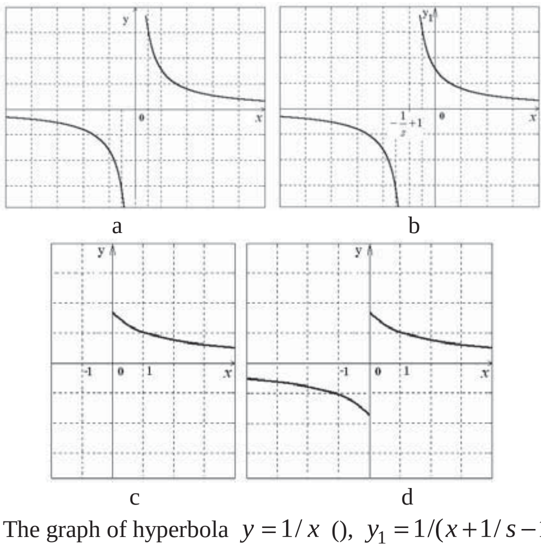

Fig. 1 The graph of hyperbola $y = 1/x$ (), $y_1 = 1/(x+1/s-1)$ (b), construction of wavelet (c, d)

The edge detector on images based on the Canny detector with the use of wavelets built by transform of the graph of power function is proposed.

REFERENCES

[1] *Mathematical encyclopedic dictionary*, edited by F. V. Prokhorov, Moscow, Soviet encyclopedia, 1988.

Marina Polyakova – Applied Mathematic Department, Odessa National Polytechnic University, 1, Shevchenko prospect, Odessa, 65044, UKRAINE,
E-mail: marina_polyakova@rambler.ru
Victor Krylov – Applied Mathematic Department, Odessa National Polytechnic University, 1, Shevchenko prospect, Odessa, 65044, UKRAINE
Natalya Volkova – Applied Mathematic Department, Odessa National Polytechnic University, 1, Shevchenko prospect, Odessa, 65044, UKRAINE