USING WEIGHTED MEDIAN FILTERING FOR FAST IMAGE SUPER-RESOLUTION

Nasonov A.V., Krylov A.S.

Lomonosov Moscow State University,
Faculty of Computational Mathematics and Cybernetics,
Laboratory of Mathematical Methods of Image Processing
http://imaging.cs.msu.ru

A method of image super-resolution (SR) is presented — reconstruction of a high resolution image from several low resolution images. A non-iterative method based on weighted median filtering is proposed.

The super-resolution is posed as a system of equations

$$A_k z = u_k, \quad k = 1,2,...,N, \tag{1}$$

where z is the high-resolution image, u_k are the given low-resolution images, $A_k z = DF_k Hz$ is a downsampling operator [1], where D is the decimation operator, H is the Gauss filter, F_k is the motion operator. We assume, that the motion is known.

In the proposed algorithm, the problem (1) is formulated in the following form:

$$(Hz)(x_n, y_n) = w_n$$

and consists in reconstruction of the blurred high-resolution image Hz with known values w_n in the given points (x_n, y_n).

Even small errors in motion estimation results in serious degradation of the reconstructed image. To make the method stable to errors in the motion vectors, an averaging is used. For every target pixel (i, j), several values w_n from a certain neighborhood of (i, j) are taken.

The following averaging methods are considered: Gauss filter [2], median filter [3] and the proposed weighted median filter which is a combination of Gauss filter and median filter.

To estimate to results, edge adaptive metrics (BEP and BEN) from [4] were used. Illustrations of super-resolution methods for scale factor 2 and 16 low-resolution images are given.
It is shown that the use of weighted median averaging enables us to reduce the influence of errors in motion vectors calculation. The work was supported by federal target program ”Scientific and scientific-pedagogical personnel of innovative Russia in 2009-2013” and RFBR grant 09-01-92474-MHKC.

Literature

1. S. Farsiu, D. Robinson, M. Elad, P. Milanfar “Fast and Robust Multi-Frame Super-Resolution” // IEEE Trans. Image Processing, Vol. 13, No. 10, 2004, pp. 1327–1344.
2. A.S. Krylov, A.V. Nasonov, O.S. Ushmaev “Video super-resolution with fast deconvolution” // Pattern Recognition and Image Analysis, 2009, Vol. 19, No. 3, pp. 497-500.
3. A. Sánchez-Beato, G. Pajares “Robust Super-Resolution Using a Median Filter for Irregular Samples” // Lecture Notes in Computer Science, Vol. 5524, 2009, pp. 298–305.
4. A.V. Nasonov, A.S. Krylov “Adaptive Image Deringing” // Proceedings of GraphiCon'2009, Moscow, Russia, October 2009, pp. 151-154.