

SUPER-RESOLUTION METHODS FOR DIGITAL IMAGE AND VIDEO PROCESSING

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INTRODUCTION

Super-resolution (SR) represents a class of signal processing methods allowing to create a high resolution image (HR) from several low resolution input images (LR) of the same scene. Therefore, high spatial frequency information can be recovered. Applications may include but are not limited to HDTV, biological imaging, surveillance, forensic investigation.

In this work, a survey of SR methods is provided with focus on the non-uniform interpolation SR approach because of its lower computational demand. Based on this survey eight SR algorithms were implemented. Performance of these algorithms was evaluated by means of objective image quality criteria PSNR, MSSIM and computational complexity to determine the most suitable algorithm for real video applications. The best algorithm has been successfully applied and its performance illustrated on real video sequences from different domains.

TABLE 1: OBJECTIVE COMPARISON OF THE IMPLEMENTED SR METHODS

	PSNR [dB]	MSSIM	Processing Time [s]
Standard interpolation	23.57	0.7475	0.002
SR nearest neighbour	27.51	0.8832	9.057
SR shift and add	27.09	0.8701	0.081
SR bilinear	28.00	0.8844	0.333
SR Delaunay	28.61	0.9030	0.104
SR Delaunay bicubic	29.02	0.9116	0.112
SR iterative back projection	26.90	0.8625	0.373
SR near optimal	26.30	0.8350	0.208
SR MAP	28.56	0.9017	0.527

GOAL OF EXPERIMENTS

The main task of the work was to find an optimal SR method applicable to real video sequences from different domains.

The algorithm should be:

- 1) reasonably computationally efficient to process a large number of color images
- 2) able to achieve good image quality for input videos with various characteristics

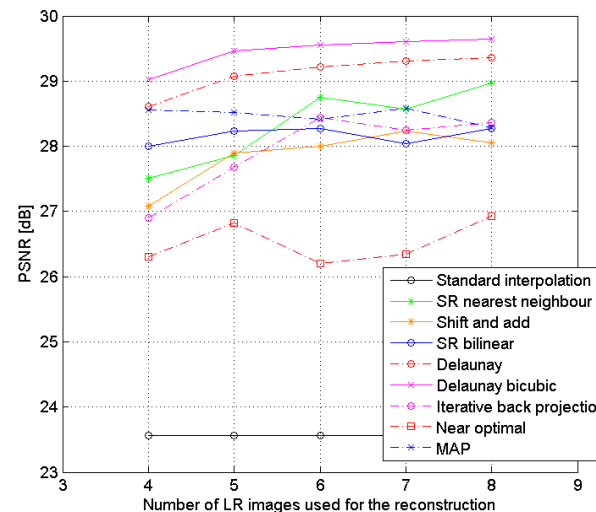


Figure 1: PSNR of the implemented SR methods vs. number of input LR images used for the reconstruction

SR METHODS COMPARISON

8 SR algorithms were compared by:

- objective image quality metrics PSNR and MSSIM
- computational complexity



Figure 2: Input image (on the left), SR output image (on the right). Video sequence was made using Olympus microscope SZX7, lens DF PLAPO. Phase correlation algorithm was used to estimate the motion between LR images with subpixel precision. SR reconstruction is performed by Delaunay bicubic algorithm. The magnification equals two. Each HR frame of the output video has been created by combining eight consecutive LR frames.

CONCLUSIONS

- Eight SR reconstruction algorithms were programmed, their PSNR, MSSIM and processing time have been measured.
- Delaunay bicubic non-uniform interpolation and MAP algorithms were proved as the most suitable for video applications and were successfully applied on real video sequences.
- Resulting SR video sequences provide image quality superior to standard uniform interpolation techniques.
- The influence of the video compression on SR performance should be further investigated.
- SR seems to be promising for medical and biological applications as well as for forensic science.