IMAGE INTERPOLATION
WITH AUTOMATIC HINTING
BASED ON GRADIENT SPARSITY

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1. Introduction

Many algorithms exist for image interpolation: linear filtering methods (such as bilinear, bicubic or Lanczos filters), nonlinear edge-adaptive methods, and a super-resolution method. Most of them are concerned with getting a high-resolution image out of a low-resolution image.

On the other hand, this paper describes a method for high-quality downscaling of digital images. The proposed method combines polyphase filtering with the process of automatic search of subpixel shifts (hinting) that maximize the image sharpness.

2. Polyphase filtering

Polyphase filtering is a traditional method of image interpolation. However downsampling requires careful selection of the filter's frequency cutoff point. The paper details this selection and discusses the difference with traditional methods of bilinear or bicubic interpolation.

3. Hinting

Hinting is a process used during font rasterization for aligning font with the raster grid. It is important for producing sharp-looking characters at small font sizes. In font rendering, hinting is done semi-automatically, using instructions in the font file. In this paper, we propose an automatic hinting algorithm for arbitrary images.

4. Gradient sparsity

To effectively estimate the image sharpness, we propose to use the gradient sparsity measure. It can be calculated as a ratio of L^2 и L^1 norms of the modulus of the image gradient.

5. Automatic hinting algorithm

The proposed algorithm does a full search of possible subpixel shifts during downscaling to find the shift which results in maximal image sharpness, as estimated by the gradient sparsity measure.

We present illustrations of the results of the proposed algorithm and demonstrate a significant sharpness increase for logotype and other synthesized images.