Efficient Techniques for Image Re-Sampling

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ABSTRACT

Digital images are formed by pixel values on rectangular grids. Many image processing applications, such as zooming (up- and down-scaling), affine transforms (translation, rotation, re-scaling), and image warping, require generating pixel values at the desired new positions based on the exiting values at the original positions. Pixel values at these new coordinates can be generated by, first, generating a proper 2-D continuous interpolation function achieving exactly the original pixel values at the existing locations and, then, re-sampling this interpolating function at the new locations in order to obtain the desired pixel values. Selecting this interpolation function plays a very crucial role for enabling one to generate a new image so that it carries the information of the original one as well as possible.

Recently, it has been observed by many authors that the above-mentioned goal can be achieved very well by using interpolation functions that are based on the use of the so-called modified B-spline functions. The team at our institute, with the key persons being Drs. Atanas Gotchev, Karen Eguiazarian, and Tapio Saramäki, improved this approach in the following two crucial manners. First, the main problem has been solved by optimizing modified B-spline functions in the frequency domain, which differs from the way of thinking of other authors. Second, very efficient structures have been developed for the practical implementation purposes. Comparisons with other existing techniques have shown the superiority of our approach both in terms of improved qualities of the re-generated images and improved structures for practically implementing the proposed overall approach.

In this talk, the properties and the synthesis of modified B-splines are briefly reviewed for achieving the above-mentioned goals. First, the combined interpolation and re-sampling problem is formally defined in both the time and frequency domains and some optimized solutions are illustrated by means of demos. Second, the proposed minimax optimization technique for designing the modified B-splines is briefly discussed together with the efficient structures. Third, experimental results are reported illustrating the efficiency of the proposed overall technique when compared with other existing ones. Finally, an attractive demo is given in order to illustrate the plethora of applying our technique to various applications.

If you are interested in our work, please contact Dr. Atanas Gotchev (Atanas.Cotchev@tut.fi).