A Fast Progressive Image Transmission Algorithm Using Linear Bivariate Splines

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Abstract. Progressive image transmission provides a convenient User Interface when images are transmitted slowly. In this paper, we present a progressive image reconstruction scheme based on the multi-scale edge representation of images. In the multi-scale edge representation an image is decomposed into Most Significant Points which represent the strong edges and Insignificant Points which represent weak edges. Image re-construction is done based on the approximation of image regarded as a function, by a linear spline over adapted Delaunay triangulation. The proposed method progressively improves the quality of the reconstructed image till the desired quality is obtained.

Keywords: progressive image transmission, delaunay triangulation, linear Bivariate splines.

1 Introduction

With the emergence of the World Wide Web, images have become an important means of communicating information in the formerly text-only Internet. When people view an image through a low speed connection, for example, via a telephone line or via wireless networks, it will take much time to transmit the whole image. Even with increased bandwidth, transmitting large images such as pictures captured by digital cameras is still relatively slow. The desire to let mobile users participate in the Internet leads to the need to cope with even narrower bandwidth and smaller client displays. If the delay is too long user will feel irritated and will give up. In order to reduce the bandwidth required for transmitting a given image in a given time, image compression techniques are commonly used to encode images. The encoded results, instead of the original images, are transmitted over the Internet. After decoding, we can obtain the decoded images, which are similar to the original ones.

Rohit Verma and Siddavatam Rajesh [1],[2],[3] have developed a fast image reconstruction algorithms using second generation wavelets and splines. Image Compression and Reconstruction algorithms have been devloped by many researchers

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Siddavatam Rajesh [4] has developed a fast progressive image sampling using B-splines. Carlos Vazquez et al, [7] has proposed interactive algorithm to reconstruct an image from non-uniform samples obtained as a result of geometric transformation using filters Delaunay triangulation [13],[16] has been extensively used for generation of image from irregular data points. The image is reconstructed by either by linear or cubic splines over Delaunay Triangulations of adaptively chosen set of significant points. This paper concerns with progressive triangulation of an image using standard gradient edge detection techniques and reconstruction using bivariate splines from adapted Delaunay triangulation until the desired quality of the reconstructed image is not obtained.

Although image compression provides an efficient and effective method to reduce the amount of data needed to represent an image, it oftentimes requires receivers to wait for the completely encoded results before reconstructing the image. If the decoded image is not the expected one, then receivers must transmit another image again. Progressive Image Transmission (PIT) techniques have been proposed to alleviate this problem by first sending a coarse version of the original image and then resending it progressively. Progressive image transmission can help reducing the latency when transmitting raster images over low bandwidth links. Often, a rough approximation (preview) of an image is sufficient for the user to decide whether or not it should be transmitted in greater detail. This allows the user to decide whether to wait for a more detailed reconstruction, or to abort the transmission. Progressive image transmission has been widely applied for many applications, such as teleconferencing, remote image database access and so on.

Existing approaches for PIT have adopted, explicitly or implicitly, the minimal distortion principle to decide the importance. For example, in the SPIHT algorithm [17], the coefficients with larger magnitude are considered more significant for they will cause larger distortion. The algorithm will therefore sort the coefficients by their magnitudes before transmission.

Some PIT techniques have adopted HVS (human visual system) weighting in spectral domain to improve the perceptual quality of the transmitted image [18],[19]. However, they did not consider the attention change in spatial domain. Popular image standards such as JPEG and JPEG2000 do support ROI coding, but they do not provide any mechanism for automatic ROI definition.

Section 2 describes the significant sample point selection and in section 3 the modeling of the 2D images using the Linear Bivariate splines is elaborated. Section 4 describes the reconstruction algorithm and it's complexity in is explained in section 5. In section 6 significant measures for reconstruction have been discussed. Experimental results along with comparison of the proposed method with APEL are discussed in section 7 and conclusions in 8.

2 Progressive Significant Sample Point Selection

This section provides a generic introduction to the basic features and concepts of novel Progressive Sample Point Selection algorithm.

Let M be a mXn matrix representing a grayscale image