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Image Coding For Aestentically Acceptable Distortion Using Depth Blurring

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Abstract: Realistic simulation of distance blurring, with the desirable properties of aiming to mimic occlusion effects as occur in natural blurring, and of being able to handle any number of blurring and occlusion levels with the same order of computational complexity will help in compressing the image. Image compression may be lossy or lossless. Lossless compression is preferred for archival purposes and often for medical imaging, technical drawings, clip art, or comics. This is because lossy compression methods, especially when used at low bit rates, introduce compression artifacts. Lossy methods are especially suitable for natural images such as photographs in applications where minor (sometimes imperceptible) loss of fidelity is acceptable to achieve a substantial reduction in bit rate. The lossy compression that produces imperceptible differences may be called visually lossless. the concept of depth-based blurring to achieve an aesthetically acceptable distortion when reducing the bitrate in image coding is proposed which is vital in lossless image compression. Depth-based blurring reduces high-frequency components by mimicking the limited depth of field effect that occurs in cameras. The Proposed algorithm performs better than the existing spatial domain methods, significantly to cope with the challenge of avoiding intensity leakage at the boundaries of objects when blurring at different depth levels.

I. INTRODUCTION

A blur filter applied in different amounts to each pixel in the image, according to a depth mask. This effect can be used to simulate a narrow depth-of-field; lens-shaped edge defocusing or tilt-shift effects. *The depth mask defines which pixels in the image will be blurred, as well as the relative amount of blurring that will occur. Brighter pixels in the depth mask correspond to the highest amount of blur. The maximum amount of blur applied by the algorithm is defined by the "Radius" parameter, and it affects pixels in the depth mask [1], [2], [3].*

Techniques for synthesizing depth of field can be classed as either multi-pass approaches or post filtering. In multi-pass approaches, high-accuracy techniques such as ray tracing are repeated from slightly different directions and averaged [4]. Al-though they are high quality, multi-pass approaches generally involve heavy computational cost. In post filtering, the rendering output itself is subjected retrospectively to synthetic depth blur-ring [5]. Postfiltering approaches can in turn be grouped into *gather* or *scatter* methods. Techniques which employ the gather method approximate depth blurring by taking the local average of pixel values around the desired location. This inherently leads to *intensity leaks* [6],[7],[8] as the intensity from sharp source pixels is spread over surrounding background that they should not influence. Approaches that employ the *scatter* method spread the intensity of each source pixel over an area. However, due to speed, scatter methods are not regarded as the choice for real-time depth blurring [9].

Circular point spread functions are developed and to cater for partial occlusion, by applying a gradual occlusion of the blur of far objects when the boundaries of nearer objects are themselves blurred.

First, the corner list array is created as follows. For each pixel location $\mathbf{x}$ in the original image, the intensity $g=G(\mathbf{x})$ and blur level $b=B(\mathbf{x})$ are read. The spread intensity $v=g/(2b+1)^2$ is paired with occlusion level $\omega=\Omega(\mathbf{x})$. The pair (v,ω) is appended to four lists, associated with the four corner points $\mathbf{c}_{11}(\mathbf{x},b)$, $\mathbf{c}_{12}(\mathbf{x},b)$, $\mathbf{c}_{21}(\mathbf{x},b)$ and $\mathbf{c}_{22}(\mathbf{x},b)$ except for corner points which lie outside the image doman D, which are ignored.

The lookup structure is the key part of the algorithm and is the part which reduces the complexity of the occlusive selective blurring from $\mathcal{O}(N^2)$ to $\mathcal{O}(\log(N)^2 N)$. The structure takes as inputs the location of a pixel (by row and column) and an occlu-sion level and outputs the sum of all of the entries with a higher occlusion level in the corner list array in the rectangle bounded by that pixel and the top-left pixel of the image. This is created first by partitioning the image domain into a hierarchy of groups of adjacent rows of pixel locations, with sets of one row at the bottom level of the hierarchy, then sets of two adjacent rows at the next level, then sets of four adjacent rows, then sets of eight adjacent rows, etc. For each level of the hierarchy, and each row group, a 1-D array (one location for each horizontal position) of trees is constructed (by *createstruct* in Algorithm, each of which can be used to efficiently look up the sum of all values in that row group to the left of the given column. These trees are referred to herein as *occlusive sum lookup trees*. The lookup tree for each location in each of these 1-D arrays can be considered to hold an array of partial sums, one for each occlusion level [10].

The final block (*Occlusive Sum Extractor*) reads the occlusive sum lookup structure for every pixel in the image. To calculate the cumulative occlusive sum for a given row, column, and oc-clusion level, the appropriate partial sums from the

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appropriate row groups are separately extracted then added together [11],[12].

1) As all non-new nodes are shared with the previously constructed trees. The added or removed trees can be retained
2) Occlusion level-value pair to a tree is of order $\mathcal{O}(log(M))$, where M is the maximum absolute value of any integer occlusion level.
3) The amount of additional storage space required each time a new occlusion level-value pair is added is $\mathcal{O}(\log(M))$.
4) The number of operations required to look up a sum value for a given for a given occlusion level is $\mathcal{O}(\log(M))$.The asymptotic complexity of the cost of applying

II. EXPERIMENTAL RESULTS

The use of a single fixation point reflects a number of foveated coding publications [5], [7], [13], [14].

III. CONCLUSION

A novel selective blurring algorithm that provides a simulation of limited depth of field, with the desirable properties of aiming to mimic naturally occurring occlusion effects and of being able to handle a continuous range of blurring and occlusion levels is Presented. Algorithm in the context of space-variant pre-filtering for bit rate reduction is obtained, with the argument that when human fixation has to be estimated because eye tracking is unavailable, blurring of this style will generally be visually more acceptable than the equivalent level of foveation blurring. The approach is particular appealing.

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