Efficient Gradient-Domain Compositing Using Quadtrees

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1 Introduction

This project is based on the work of Agarwala [1], that describe a hierarchical approach to improving the efficiency of gradient-domain compositing, a technique used to stitch images without visible seams. This method combines the gradients of the source images to form a vector field, then a composite image whose gradient field best matches this vector field is reconstructed by solving a linear system. This operation is described by Pérez [2] in the case of seamless copying a region from a image into another.

One problem of this approach is that it is not well suited for multi-megapixel digital images, because it is necessary to solve a very large linear system, which requires a very big ammount of memory and can take a very long time to be computed.

Agarwala developed an approach to gradient-domain compositing planned to reduce the scale of the problem. This is done subdividing adaptively the domain using a quadtree, in a way that smoother areas of the solution are interpolated using fewer variables.

Our goal in this project is to implement the method described by Agarwala, make tests, and somehow extend the ideas of the algorithm.

2 Extension Idea

There are other problems that look up one image that best matches a specified gradient-field, like high dynamic range compression, intrinsic image recovery, shadow removal, flash artifact correction, reproducing photographic look, and alpha matting. In this project we can analyze this other problems to see in which ones the algorithm described by Agarwala is suitable. Not all of them can be suitable because the algorithm requires that the problem can be transformed into a space where the solution is mostly smooth, and the pattern of smoothness can be predicted a priori.

Other idea motivated by Agarwala that can be explored is compute a solution for each tile of an image independently, thus creating a initial solution with non-zero residuals only along tile boundaries, where a quadtree could be subdivided and used to compute an offset to the initial solution, correcting errors introduced by tile-by-tile computation.

3 Development Plan

- September: implementation of the basic gradient-domain compositing method.
- October: implementation of the gradient-domain compositing using quadtrees.
- November: development of the extension ideas; obtaining of expected results; creation of the webpage and presentation.

References

[1] Aseem Agarwala. Efficient gradient-domain compositing using quadtrees. *ACM Trans. Graph.*, 26(3):94, 2007.

[2] P. Pérez, M. Gangnet, and A. Blake. Poisson image editing. *ACM Transactions on Graphics (SIGGRAPH'3)*, 22(3):313–318, 2003.