Interactive Editing of Massive Images

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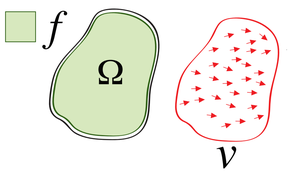
Gigapixel images are becoming increasingly popular due to the availability of high-resolution cameras and inexpensive robots for the automatic capture of large image collections. Even larger images, massive in size, are freely distributed online, such as aerial satellite photography. Yet, the full potential of such imagery is only realized by artists and analysts enhancing, manipulating, and/or compositing the original images.

Gradient Domain Image Editing

Given a guiding gradient field v, these techniques attempt to find a closest-fit image in a least-squares sense, f.



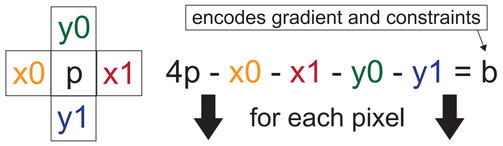
$$\min_f \iint_\Omega |\nabla f - v|^2$$

Seamless Cloning - When "pasted" into a scene, an image's boundary is locked to match the background giving a seamless transition.

Panorama Stitching - Multiple images are combined and the unwanted seams are ignored in the gradient field.

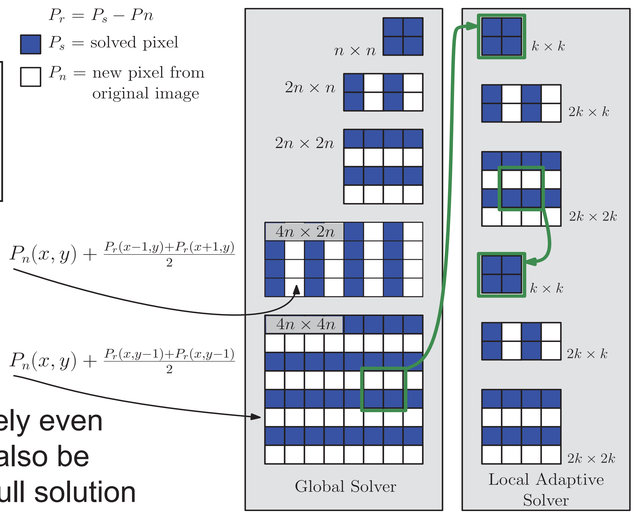
Solving

Often the problem is solved as a large linear system where every pixel in the image is an uknown.



A gigapixel image would have over a billion unknowns. For images of this size, current state-of-the-art techniques take well over an hour to compute a solution on a standard desktop. This is not acceptable for an iterative artistic process.

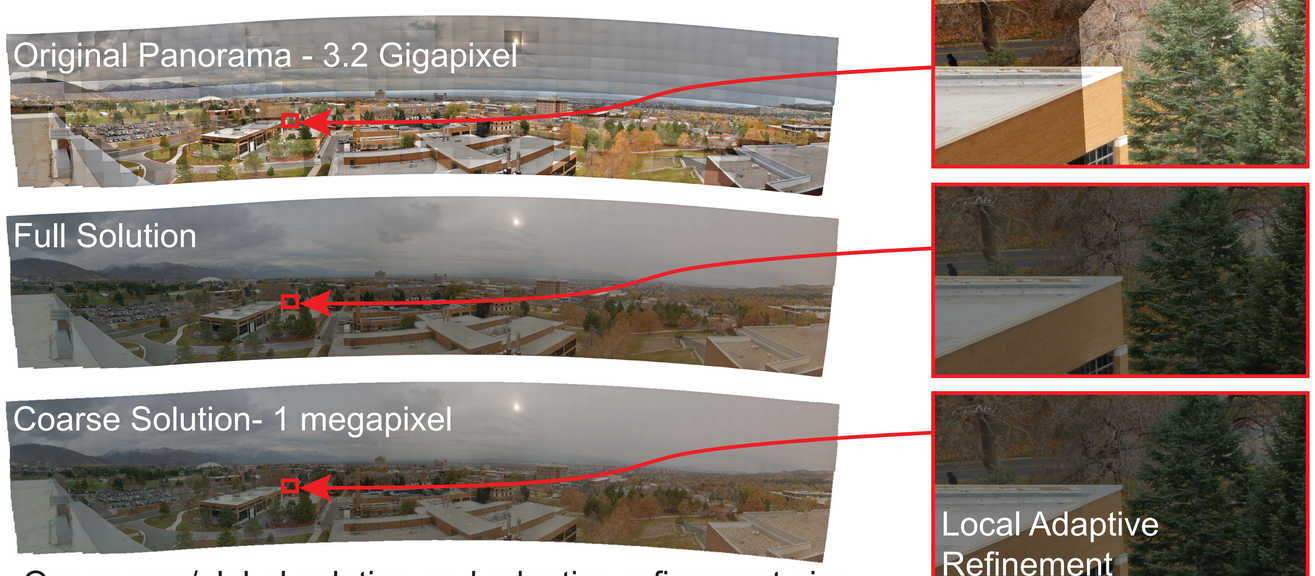
Our Interactive Editing System



Our system computes an initial solution using a coarse resolution of an image. When combined with the scheme outlined to the right, our system can produce a visually accurate solution iteractively even at resolutions where no solution exists. This can also be used to drive an out-of-core solver to produce a full solution with timings that rival the best current methods.

Results

Panorama stitching



Our coarse/global solution and adaptive refinement give the user a visually accurate preview of the full solution.

Seamless Cloning