Title

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**Abstract**

This paper presents a method of compositing red, green, and blue digital images, as from separate photographic plates, into a single color image. The advantages of this method are that it is mathematically simple and relatively simple computationally. However, this method is only appropriate when the source images are not rotated or skewed relative to one another, e.g. for images taken with a tripod of a stationary subject.

Keywords

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# INTRODUCTION

In the first decade of the twentieth century, Sergey Prokudin-Gorsky toured the Russian Empire on a commission from the Czar to take color pictures of the Russian landscape, culture, and architecture. Since this was well before the advent of color film, Gorsky took three separate exposures of each scene—one each through a red, green, and blue color filter. The resulting photographic plates represent the red, green, and blue color planes of a color photographic image.

The photographic plates have been digitized by the United States Library of Congress, and are available as “strip” images, with the three color components arrayed vertically in a single image. Each of these strip images is about 3700 by 9600 pixels, meaning that each of the component images is about 3700 by 3200 pixels, or nearly 10 megapixels.

The goal of this project was to digitally separate the strip image into the three color plane images and composite them into a single color image. The source images had some limited scratches and noise, which was worst around the edges of each image. The edges of the image were also uneven. Most importantly, the three images must be registered so that they are aligned properly.

Most recent publications on aligning multiple photographs are tailored for making high dynamic range (HDR) composite images. Although this is a similar task, the challenges of registering different color planes are different from those of registering the component images of an HDR composite. HDR images may have differences in luminance, but they contain the same features. These images have different features depending on which features appear in which color plane(s). Many HDR processing techniques are also designed to compensate for excessive camera movement, such as rotation and skew, that result from handheld photography. Since Gorsky’s pictures were long exposures taken with the aid of a tripod, these techniques are entirely unnecessary for this task.

Instead, this method relies on the assumption that the three image plates need only be translated to register them properly. With this assumption, which proved valid, advanced transforms are unnecessary, and are replaced with simple shifting operations. The translational offsets are found by discarding the edges and then simply maximizing correlation between the color images. Once registered, the three images can be composited by using the values from each component image as the respective color component values in the output color image.

Based on these assumptions and ideas, several variations were tried for registering the images, and the results for a selection of Gorsky’s images were compared to determine how effective each method was at creating composite images.

# Choosing Appropriate Algorithms

The criteria for selecting the algorithms for this project were that they correctly register the source images and that they run in a reasonable time (less than one minute to create a single composite using a typical contemporary PC).

As discussed above, much contemporary research in this field is for creation of HDR composites. One technique, described by Greg Ward in [1], uses median-threshold binary (MTB) image pyramids to quickly find translational offsets between images. This method has two main advantages: it is very fast and it is insensitive to differences in median value between source images. The speed of this algorithm is desirable in this application. The second feature is highly desirable in HDR composites, but is of no use in generating color composites. Experiments with this method found that it discarded too much information from the component images to make them useful--

The most important

**Software Implementation**

**Results**

Summary

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References