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Rumination of Image Artifacts

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Abstract:

This paper explains different types of artifacts and how they can be removed. In the milieu of image processing, we define artifacts as flaw in the image captured. Artifacts are the outcomes of either capturing device defect or the disturbances in the medium. These obstructions must be addressed because they are one of the sole reasons in loss of information. We basically refer to the images used in medical application and geo-informatics. These images carry sensitive information and a minor defect can be harmful. These artifacts in such images should be detected before using them for deriving results.

Keywords: Artifacts, inpainting, dead pixels and image enhancement

1. Introduction

The defect which is caused by false equipment or technique during perception of any information that is visual is known as an artifact. For example, if we talk about the image registration process in the area of remote sensing the summation approximation and interpolation of signals that are continuous will fail against these artifacts. Artifacts are the root cause of the alterations of gradients, local optima shift and asymmetric structure of registration. [xiii]



Figure 1: Image with artifacts



Figure 2: Location of artifacts

The figure 1 shows an image with artifact that can be seen clearly and figure 2 shows the output of a program that shows the location of it. The problem is how to get rid of these artifacts. It depends upon the type of it. In this paper, we will discuss few types of artifacts and how they can be removed.

The importance of artifact removal is not only because they cause loss of information,, but also problems they can cause in image fusion in the field of remote sensing. In image fusion we take a multispectral image which is a spectrally rich image and panchromatic image which is spatially rich. These images are co registered based on similarity due to artifacts they exhibit a shift in the similarity hence images cannot be registered properly.

2. Problems and Solutions

The various problems depend upon the cause, whether it is the device behavior or medium disturbance. Based on the type of an artifact the removal can be done. Since each artifact has its own property some hide the information beneath and some inhibit missing information. Most commonly seen artifacts are cracks in the picture, a light problem, red eye, dead pixel etc. There are various types

of methods that are used to remove such artifacts based on their property and type. We describe four basic types of artifacts in the following table.

	Type of Artifact	Solution
1	Cracks, scratched spots in photographs	Inpainting and process of hole filling.
2	Uniform loss of contrast	Focus on removing camera defects
3	Occlusion effect	Use of blur
4	Dead Pixels	Use of surround pixel values.

Table 1: Different types of Artifacts

2.1. Image Inpainting and Hole-Filling

Various kinds of inpainting and other techniques have been introduced so far to improve the defects in an image. [i, ii, iii] [Liu et al. 2008] worked on structured artifacts by using symmetry from images say fences from images. Such methods are very simple and do not require any knowledge about physics, as they depend upon the neighboring pixels to derive information of imperfect regions. As the information is very much accessible we can recover it point wise.

Note that our point wise operations and image inpainting methods are not mutually exclusive – the former can be used where the scene is partially visible, after which the latter can be used on the remaining, completely-blocked areas. [xiv]

Inpainting, a set of techniques for making undetectable modifications to images, is as ancient as art itself. Applications of image inpainting range from the removal of an object from a scene to the retouching of a damaged painting or photograph.[xv]In other applications such methods can be used like in filming or photography the imperfections can be removed for example red-eye or artifacts caused by light. [xv, vii]

The following partial derivative equation was given by osher and his colleagues

$$\frac{\partial I}{\partial t} = \nabla^{\perp} I \cdot \nabla \Delta I$$

I= Image Intensity inside hole that is region to be inpainted

∇^{\perp} = perpendicular gradient ($-\partial y, \partial x$)

Δ = Laplace Operator

2.2. Modeling and Removing Camera Artifacts

[Talvala et al. 2007] studied camera-veiling glare, which is, in effect, a uniform loss of contrast in the images. [Raskar et al. 2008] proposed the use of a light field camera to remove lens glare. Recently, [Koreban and Schechner 2009] showed lens glare can be used to estimate the geometry of the source and the camera. Another body of work considered image artifacts caused by scattering of participating media and developed techniques for dehazing [Schechner et al. 2003], contrast restoration in bad weather [Narasimhan and Nayar 2003], and underwater imaging [Schechner and Karpel 2005]. Two interesting recent work on dehazing [Fattal 2008; He et al. 2009] combines both statistical and physically-based approaches. While we draw inspiration from these methods, and the broader area of computational photography, we focus on different visual effects. In the context of dirty camera lenses, [Willson et al. 2005] considered the image appearance of dust that lies on a transparent lens cover. They reported both “dark dust artifacts” (*i.e.*, attenuation) and “bright dust artifacts” (*i.e.*, intensification) but only handled the “dark dust artifacts.” [Zhou and Lin 2007] studied artifacts caused by the attenuation due to dust on image sensors. [xiv]

2.3. Depth from Defocus and Large Apertures

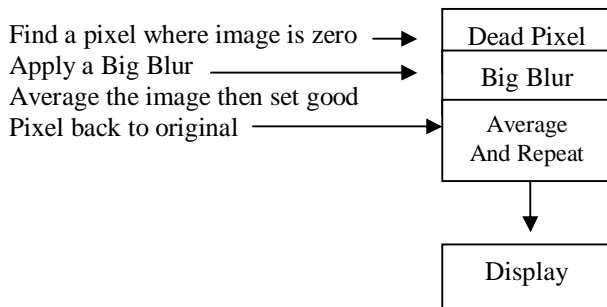
In the limiting case of a very large aperture and the camera focused on the target scene, the occlude layer will be heavily defocused and completely blurred out in the final image, as demonstrated by recent work on synthetic apertures using dense camera arrays [xi]. For conventional consumer cameras, however, it is less practical to have such large apertures. Thus, this occlusion effect has almost always been considered a problem in depth from defocus methods [Watanabe and Nayar 1996].

→ Solution

Previous works [Favaro and Soatto 2003; Hasinoff and Kutulakos 2007] took occlusion into account and proposed methods to recover depth and scene textures from a stack of images with different focus or aperture settings. [McCloskey et al. 2007] recently proposed an interesting method to remove partial occlusion blur from a single image using geometric flow, although it is not obvious how to extend the method for multiple, complex occlusion objects such as curtains or tree branches. [xiv]

2.4. Dead Pixels

The sensors sometimes suffer from the common problem of unresponsive pixels. These pixels are often termed “dead pixels” and affect the quality of both the visual image and the underlying data. Dead pixels are those pixels whose measurement does not have any correlation with the true scene that is being measured. They severely degrade the quality of measured imagery and require that their measurements be replaced with more appropriate values to improve image quality to an acceptable level that depends on the subsequent processing and display that the image is subjected to. The dead pixel represents a fundamental loss of information that cannot be recovered.[ix, x]



3. Conclusion

Artifact removal has applications in various fields where image processing is required. Areas like medical imagery, remote sensed images and much more where images should not have any faults in them as they have the useful information even at the pixel level, therefore these artifacts should be taken care of and removed before using the image containing it. This paper addresses few methods like image in painting that is where there is missing information in the image or removal of dead pixels by using the average value of surrounding pixels and other methods. These methods are specific to a set of artifacts. There are other Artifacts that are known as Image ghosts, RF noise or artifacts due to motion can also be studied and considered as well.

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