

SCENE RECONSTRUCTION FROM A SINGLE IMAGE FOR CIRCULAR MOTION BLUR

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Received February 2009; revised September 2009

ABSTRACT. *In this paper, we present a reconstruction algorithm to obtain sharp images from the noiseless circular motion blurred images. The reconstruction algorithm is divided into two phases: motion estimation and restoration phase. Motion estimation is performed prior to the restoration phase. A digital circle generating algorithm is employed to decompose the spatially variant blur into the spatially invariant one. Reconstruction of a sharp image from a single blurred image is defined as a least square problem. The solution is obtained by using the Lagrange multipliers-based restoration method. Since the solution is a vector obtained from each circular motion path, the restoration method is applied to a series of concentric circles to obtain a complete restored image. Finally, we apply the median filter to remove the empty pixels distortion in the restored images. Experimental results show the feasibility of the presented scene reconstruction algorithm.*

Keywords: Circular motion blur, Motion estimation, Image restoration, Least square problem

1. Introduction. Circular motion blurred images are sometimes unavoidable when we use a digital camera, medical imaging equipments, or the other kinds of imaging system. The blurred image can be solved by using hardware approaches or software approaches. Using the hardware approaches usually spend high costs. Therefore, it is recommended to choose the software-based approaches. The solutions can be obtained by using digital image processing algorithms, such as image restoration. Obtaining the sharp images from the circular motion blurred images by using image restoration procedures is an interesting and challenging problem. As the circular motion blur is spatially variant, the corresponding degraded images cannot be restored by using image restoration algorithms that do not deal with the spatially variant point spread function. Thus, restoring the spatially variant blurred image is a difficult problem.

Generally, the spatially variant blurred image restoration problem can be solved by using the direct restoration approaches or the indirect restoration ones. In the direct restoration methods, the blur is removed from an image under consideration of the spatially variant point spread function. In contrast, the second approaches reduce the spatially variant restoration problem into the spatially invariant one by using a decomposition technique. Then, the blurred image is restored by using the spatially invariant restoration algorithms. Many researchers have proposed methods to directly restore the spatially variant blurred image [1–3]. In [3], the blurred image was restored by using a variational method that estimates simultaneously the sharp image and the depth map, based on the minimization of a cost functional. However, the author considered the special case, i.e. the camera moves in one plane perpendicular to the optical axis without any rotations.