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基于视频序列的局部运动模糊车辆图像复原算法研究

Research on Restoration Algorithm of Partially Motion-Blurred Images of Vehicle Based on Video Sequence

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摘　要

图像复原是图像处理技术中一个极具应用价值的重要研究领域，也是学术界和工业界一直以来的研究热点之一。运动模糊图像的复原作为图像复原的一种，主要研究如何从一幅因运动而造成模糊的图像中提取有用信息，复原出清晰的原始图像，具有重要的现实意义。

与全局运动模糊图像的复原相比，局部运动模糊图像的复原不仅需要估计图像退化过程的点扩散函数PSF（point spread function），利用PSF反卷积去模糊，而且需要检测和提取模糊区域，甚至在某些条件下还需要判别模糊区域的模糊类型。为了有效地复原局部运动模糊的车辆图像，本文从以下几个方面展开了基于多帧的车辆图像复原算法研究：

首先，为了准确、快速地检测和提取图像的模糊区域，提出一种基于小波变换的模糊检测改进算法，该算法通过统计分析小波图像中各类边缘的数量，获取含有模糊物体的可能区域，再计算功率谱斜度进一步缩小模糊区域，最后应用Matting技术把标记的模糊区域从图像中提取出来。大量仿真实验表明，该算法可以有效检测和提取图像中的局部模糊区域。

其次，针对提取的模糊区域，提出一种基于多帧图像和透明度的算法，该算法利用两帧间的位置关系和单帧中半透明区域的大小估计两个关键的运动模糊参数（运动模糊方向和运动模糊尺度），从而获取图像退化过程的PSF。实验证明，该算法误差较小、计算简便、鲁棒性强。

最后，针对图像反卷积计算引起的振铃效应，提出一种将图像融合引入到L-R迭代过程的算法，该算法充分利用多帧信息，有效地抑制图像反卷积过程中产生的振铃效应，使得复原图像的细节信息更清晰准确。

实验研究表明，本文提出的算法能针对局部运动模糊车辆图像的模糊区域进行有效地复原，并且复原效果良好。

局部运动模糊；多图像复原；运动模糊参数；透明度；振铃效应

Abstract

Image restoration is a very important research field with highly application value in the area of image processing technology, also in academia and industry has been one of the research hotspots. As a kind of image restoration, motion-blurred image restoration which mainly discusses how to extract useful information from motion-blurred image and to restore the original clear image, has very important significance.

Compared with global Motion-blurred image restoration, the partially motion-blurred image restoration not only requires the estimation of PSF(point spread function) in the image degradation process, but also requires the detection and extraction of fuzzy regions , and even in some conditions distinguishing blur types of fuzzy regions is needed. To effectively restore the partially motion-blurred image of vehicle, this paper discusses vehicle image restoration algorithm based on multi frames from the following aspects.

Firstly, in order to detect and extract fuzzy regions in the image accurately and fast, we propose an improved fuzzy-detected algorithm based on wavelet. The algorithm can obtain possible regions including fuzzy object through the statistics and analysis of the number of all kinds of edges in the wavelet image. And then we compute the power spectral slope of fuzzy blocks in divided fuzzy region to further narrow the region. After capturing the precise fuzzy region, using Matting technology extracts fuzzy region marked from the image. A large number of simulation experiments show that, the algorithm can effectively detect and extract partially fuzzy region from a motion-blurred image.

Secondly, for the extraction of fuzzy region, an algorithm is presented based on multi-frame image and transparency. In this algorithm we estimate for two key fuzzy parameters (the motion-blurred direction and the motion-blurred length) according to both of positional relationship between the size of translucent region

in a single frame and its adjacent frame. And then PSF in the image degradation process is obtained. Experiments show that, the algorithm has smaller error, simple calculation, and strong robustness.

At last, for the ringing effect introduced by iteration deconvolution, we make full use of multi-frame information and propose an algorithm in which image fusion is joined into the iterative process of L-R deconvolution. The restored images are clearer and more precise after inhibiting the ringing effect.

Experiment results demonstrate that, for the partially motion-blurred images of vehicle, the restoration algorithm proposed in this paper is effective and can achieve satisfied result.

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