Recovering Blurred Images to Recognize Field Information

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Information retrieval from images that involves objects recognition is now in high demand for many applications including military tasks. Using Unmanned Aerial Vehicle equipped with digital cameras forimages recording allows to solve unsolved previously problems. The examples of solving critical problem using this approach include detecting fire sources, spotting pipe leaking, finding railroads failure, etc. The image should satisfy some quality requirements in order to allow objects recognition. On the other hand, using images recording from Unmanned AerialVehicle is affected by blurring due to the video cameras random vibration. The main reason of vibration is air turbulence due to the strong wind (Sieberth T. et al, 2016). The level of the image blurring depends on the amplitudes of camera displacement due to the vibration in case when vibration amplitude would exceed the threshold the image should be deblurred. Some of image recognition applications require real time recognition and consequently rapid deburring.

There are two major directions in image deconvolution: blind and non-blind. The non-blind image deconvolution algorithms recover blurred images with unknown blur kernel. Such methods as Lucy-Richardson, Wiener Filters achieve high resolutions in image deburring. However, it requires hundreds of iterations to obtain original image approximation. The proof of such iterative algorithms convergence is covered in such publications (Khan et al, 2013).

The non-blind image deburringrequires two steps. The first step reveals to defining blur Kernel and second one consist in finding unknown original image from the blur equation. The first step can be resolved by matching known vibration characteristics to blur Kernel. The second requires to solve non-linear equation. In case when Kernel is a Gaussian functionis given constructive formulas for the deburring kernels in terms of Hermite polynomials (Hummel et al, 1986).

The numerical solution is defined for (Basran et al, 2019) for non-linear diffusion equation is known to be a significant application in solving image processing issues. Per authors analysis, an intense amount of computations is needed in filtering the image as the sizes that keep getting bigger. Authorsproposed speed up computation in solving the developed linear system with the faster iterative method.

The current research covers method of deblurring image with arbitrary Kernel using theory of Hypernumber (Burgin and Dantsker, 1995), (Burgin, 2010, 2012). Applying Hypernumber for solving complex operator equation show high computational efficiency (Burgin and Dantsker, 2015). The sequential Hypernumber solution for deblurred image is identified from solving linear equation toward difference between digital image sequential current and next Hypernumbers. The equation is resolvedintegrating by parts blurring integral.

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