

# Long Range Image Enhancement

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## Abstract

Turbulent pockets of air in the atmosphere blur and disrupt the Point Spread Function (PSF) of a surveillance system. The PSF peak is offset in location, changed in size and in short exposures (or mild conditions) noticeably fragmented or speckled. These effects result in what is called heat shimmer or scintillation. The turbulence also causes the effective PSF convolution kernel to vary over time as well as across the image. When doing long range surveillance even mild turbulence can significantly degrade the surveillance system performance. This paper discusses an image processing method that tracks the behaviour of the PSF and then de-warps the image to reduce the disruptive effects of turbulence. Optical flow, an average image filter and a simple unsharp mask is employed to respectively track the centre of the PSF, de-speckle the image and regain the sharpness of the image. The algorithm is efficient enough to process 720p video at 10 frames per second on low power CPU-only platforms such as an Intel i5 NUC.