Transformer-based Denoising of Microlens Array Shearing Interferogram

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Microlens arrays are the key component in the next generation of 3D imaging systems, for it exhibits some good optical properties such as extremely large field of view angles, low aberration and distortion, high temporal resolution, and infinite depth of field. During microlens array production, problems of mold making, and non-uniform expansion occur, caused by the heating and contraction caused by cold, and easily generate flaws. Interferometry is an inherent high-precision and well-established optical technique for extracting the phase variation of an interferogram and has been appealing for characterizing optical phenomena in physics, chemistry, and engineering. Because of self-interference in shearing interferometry, it is more flexible for use in interferometer. However, a large amount of noise in the interference pattern seriously affects the phase reconstruction and measurement accuracy. Compared with traditional denoising methods, such as Gaussian filter, non-local mean filter, and bilateral filter, deep learning-based methods can automatically learn complex patterns and structures in images without manually designing features or filters. This paper attempts to introduce a transformer-based method, Restormer, to reduce the noises in interferograms of microlens arrays generated by shearing interferometry, in which multiDconv head transposed attention and gated-Dconv feed-forward network are introduced to perform linear computation complexity and controlled feature transformation. A series of comparison experiments are conducted to show the superiority of Restormer.

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