Single frame phase retrieval with a deep learning method

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In the field of precise 3D reconstruction, fringe pattern profilometry (FPP) is always regarded as the preferred method for it provides relatively higher accuracy. However, the phase acquisition process generally requires a sequence of images with different phase shift, which is rather time-consuming. Thus the application scenario of FPP is greatly limited and this has long been a bottleneck in practice. Although single-frame based phase retrieval algorithms like Fourier transform profilometry (FTP) has been proposed and extensively studied, they still suffer from relatively unbearable loss of accuracy. In response to this problem, we take advantage of the deep learning techniques and present a deep-learning based phase acquisition system in which the phase can be acquired by a single frame of fringe pattern image. The network is constructed according to the procedure of phase retrieval, which is trained by thousands of fringe pattern images with the phase data being known in advance. And it can predict more preciously the phase of a new fringe pattern map. As large data set is demanded for the training and testing, we also propose a method to prepare the fringe pattern dataset and phase data, which will be opened to other researchers and free them from the massive work of building new datasets. In addition, the generated dataset is even more flexible and versatile than real captured pictures in some aspects, which enables the trained network to be more adaptable and flexible. Experiments illustrate the effect of our method which will be promising for practical use.