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An Accurate Computation of 2D Zernike Moments via Fast Fourier Transform

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Abstract : Object detection and object recognition are essential components of every computer vision system. Despite the high computational complexity and other problems related to numerical stability and accuracy, Zernike moments of 2D images (ZMs) have shown resilience when used in object recognition and have been used in various image analysis applications. In this work, we propose a novel method for computing ZMs via Fast Fourier Transform (FFT). Notably, this is the first algorithm that can generate ZMs up to extremely high orders accurately, e.g., it can be used to generate ZMs for orders up to 1000 or even higher. Furthermore, the proposed method is also simpler and faster than the other methods due to the availability of FFT software and/or hardware. The accuracies and numerical stability of ZMs computed via FFT have been confirmed using the orthogonality property. We also introduce normalizing ZMs with Neumann factor when the image is embedded in a larger grid, and color image reconstruction based on RGB normalization of the reconstructed images. Astonishingly, higher-order image reconstruction experiments show that the proposed methods are superior, both quantitatively and subjectively, compared to the q-recursive method.

Keywords : Chebyshev polynomial, fourier transform, fast algorithms, image recognition, pseudo Zernike moments, Zernike moments
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