

APPROXIMATING 3D SHAPE THROUGH BEZIER CURVE AND MOMENTS IN DISCRETE COSINE TRANSFORM

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ABSTRACT. *Shape from focus (SFF) is one of the passive optical techniques for 3D shape recovery of an object from its 2D images. This paper presents a new SFF method based on moments in discrete cosine transform (DCT) domain and Bezier curve. We applied one-dimensional DCT on neighborhood vector comprising pixels from three dimensions. Focus values are computed by taking central moments of AC energy components and an initial depth map is recovered by obtaining the location of the maximum focus values among the sequence. To obtain an accurate 3D shape and to reduce the noise sensitivity of the focus measure, focus values around the peak of the focus curve are interpolated through Bezier curve. The proposed method is tested and results have been compared with existing approaches by using image sequences of synthetic and real objects. The experimental results demonstrate the effectiveness of the proposed scheme.*

Keywords: Bezier curve, DCT, Focus measure, Shape from focus

1. Introduction. Shape from focus (SFF) is a passive optical method for 3D shape reconstruction of an object from its 2D images. It has numerous applications in computer vision, range segmentation, consumer video cameras, and video microscopy [1-3]. In SFF methods, a sequence of images is acquired either by relocating the object of an unknown 3D shape along the optical axis in small steps or by changing the focal length of the lens in the camera. A sharpness criterion or a focus measure is applied on all the pixels in each frame for measuring the focus quality. The sharpest pixel among the sequence provides depth information. Furthermore, an approximation method is performed to enhance the initial results.

Usually in conventional SFF methods, image sequence is convolved with Laplacian or Sobel operators and the focus value for each pixel is estimated by aggregating the resultant values within a small 2D window. The size of this window affects the depth map accuracy as well as computational complexity [4,5]. Ahmad and Choi [6] suggested summation of focus values within a 3D window for computing accurate depth maps. It exploits the focus information from neighboring frames in addition to the frame in question. However, this approach is computationally expensive. Among the variety of focus measures in the literature, some focus measures are reported in the discrete cosine transform (DCT) domain [7-9]. Again, in these methods focus values are computed by aggregating energies of DCT coefficients. It is also revealed that each focus value in the window differently affects the focus quality. Moreover, the aggregation of focus values in