Depth from Defocusing Using Local Standard Deviations of Images

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ABSTRACT

The technology of 3D imaging out of 2D images for post-processing and application purpose has been extensively researched for many years. Recent years saw many papers on transformation methods that map images onto space domain, frequency domain or time-frequency domain, followed by optical pre-analysis to derive a relation between image variations and distances from images, based on which 3D models are then constructed. This study breaks apart from earlier researches in being the first to statistically analyze the standard deviations of image textures which vary under different camera parameter, and constructs 3D object based on the relative distances obtained through texture comparison of the object ’ s images taken under different camera parameters. This paper presents the scope of this study, with detailed description of its uniqueness and how the underlying algorithms are formulated.

Keywords : Local Standard Deviations

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REFERENCES

[1] Pentland, A. “ A New Sense for Depth of Field, ” IEEE Trans. Pattern Analysis and Machine Intelligence, vol. 9, pp. 523-531, 1987.

[2] Paolo Favaro and Stefano Soatto, “ A Geometric Approach to Shape from Defocus, ” IEEE Transactions on Pattern Analysis and Machine Intelligence, vol.27, no.3, pp.406-417, 2005.

[3] Muhammad Asif, Aamir Saeed Malk and Tae-Sun Choi, “ 3D Shape Recovery from Image Defocus using Wavelet Analysis, ” IEEE Conf. on Image Processing, I-1025-8, 2005.

[4] Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, Digital Image Processing using MATLAB, Pearson Prentice Hall, 2004.

[5] Surya, G. & Subbarao, M. ” Depth from defocus by changing camera aperture: a spatial domain approach, ” IEEE Conf. on CVPR, pp. 61 – 67, 1993.

[6] Subbarao, M. & Wei, T. C. “ Depth from Defocus and Rapid Autofocusing: a Practical Approach, ” IEEE CVPR, pp 773 – 776, 1992.

[7] Subbarao, M. “ Parallel Depth Recovery by Changing Camera Parameters, ” In. Proc. IEEE Intl. Conf. on Computer Vision, Florida, USA, pp 149-155, 1988.
[8] Subbarao, M. and Natarajan, G. “ Depth recovery from blurred edges ” , CVPR, Ann Arbor, Michigan, pp. 498-503, June 1988.
[9] Xiong, Y. & Shafer, S.A. “ Depth from Focusing and Defocusing, ” IEEE Computer Society Conf. on CVPR, pp 68 – 73, 1993.
[10] Ens, J. and Lawrence, P. “ An Investigation of Methods for Determining Depth form Focus, ” IEEE PAMI, vol. 15, no.2, pp. 97-108, 1993.
[11] Swain, C., Peters, A., and Kawamura, K., “ Depth estimation from image defocus using fuzzy logic, ” IEEE conf. on computational Intelligence, vol. 1, pp. 94-99, June 1994.
[12] Xiang-cheng Chen, Sheng Yang, and Ya-jun Wang, “ Research on 3D Shape reconstruction using Uneven Defocusing Model, ” IEEE Conf. on Mechatronics and Automation, August 2007.
[13] M. Potmesil and I. Chakravarty, "Synthetic image generation with a lens and aperture camera model," ACM Trans. Graphics, vol. 1, no. 2, pp. 85-208, Apr. 1982.