

# Barcode identification in blurred images

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**References:**

[1] A. Beck, M. Teboulle, Convex Optimization in Signal Processing and Communications, D. Palomar and Y. Eldar Eds., Cambridge University Press, 2010.

[2] Amir Beck and Marc Teboulle, Fast Gradient-Based Algorithms for Constrained Total Variation Image Denoising and Deblurring Problems, IEEE Transaction Image Processing, 2009.

[3] Ando, S., Image field categorization and edge/corner detection from gradient covariance, IEEE Trans. Pattern Anal. Mach. Intell., vol. 22, no. 2, pp. 179-190, Feb. 2000.

[4] Aristidis C. Likas, Nikolas P. Galatsanos, A variational Approach for Bayesian Blind Image Deconvolution, Signal Processing, IEEE Transactions, 2004

[5] Arnow, T. L. and Bovik, A. C., Foveated visual search for corners, IEEE Trans. Image Process., vol. 16, no. 3, pp. 813-823, Mar. 2007.

[6] Babacan, S.D. Molina, R. Katsaggelos, A.K. Northwestern University., Evanston, Parameter Estimation in TV Image Restoration Using Variational Distribution Approximation, IEEE Transactions on Image Processing, 326-339, 2008.

[7] Ballard, D. H., Generalizing the Hough Transform to Find Arbitrary Shapes, CVGIP, 13, pp. 111-122, 1981.

[8] Barber, D., Bayesian Reasoning and Machine Learning, Cambridge University Press, 2011

[9] Barber, D., Bayesian Reasoning and Machine Learning, Cambridge University Press, 2011.

[10] Berne Jeahne, Practical handbook on image processing for scientific and technical applications, CRC Press LLC, 2004.

- [11] Chan T.F., Chiu-Kwong W., Total variation blind deconvolution, Image Processing, IEEE Transactions, 1998.
- [12] Cootes, T. F., Edwards, G. J. and Taylor, C. J., A Comparative Evaluation of Active Appearance Model Algorithms, In: P. H. Lewis and M. S. Nixon (Eds), Proc. British Machine Vision Conference 1998, BMVC98, 2, pp. 680-689, 1998a
- [13] D. Conte, P. Foggia, C. Sansone, M. Vento, Thirty Years Of Graph Matching In Pattern Recognition, International Journal of Pattern Recognition and Artificial Intelligence, 2004.
- [14] Gao, X., Sattar, F., and Venkateswarlu, R., Multiscale corner detection of gray level images based on log-Gabor wavelet transform, IEEE Trans. Circuits Syst. Video Technol., vol. 17, no. 7, pp. 868-875, July 2007.
- [15] Gene H. G., Per C. H., Dianne P. O., LearyTikhonov regularization and total least squares, SIAM Journal on Matrix Analysis and Applications, 1999
- [16] Hill, A., Cootes, T. F., Taylor, C. J. and Lindley, K., Medical Image Interpretation: A Generic Approach using Deformable Templates, J. Med. Informatics, 19(1), pp. 47-59, 1994.
- [17] Hiroko Kato, Keng T. Tan, Douglas Chai, Barcodes for Mobile Devices, April 2010.
- [18] Hough, P. V. C., Method and Means for Recognizing Complex Patterns, US Patent 3969654,1962.
- [19] Jeongtae Kim and Soohyun Jang, High order statistics based blind deconvolution of bi-level images with unknown intensity values, Opt. Express 18, 12872-12889 (2010).
- [20] Jos M. Bioucas-Dias, Mrio A. T. Figueiredo, A New TwIST: Two-Step Iterative Shrinkage/Thresholding Algorithms for Image Restoration, IEEE Transactions on Image Processing, 2007.
- [21] Joseph E. and Pavlidis T., Bar code waveform recognition using peak locations, Pattern Analysis and Machine Intelligence, IEEE Transactions, 2002.
- [22] Joseph, E.; Pavlidis, T., Bar code waveform recognition using peak locations, Pattern Analysis and Machine Intelligence, IEEE Transactions, Jun 1994.
- [23] K. Gurney, An Introduction to Neural Networks, CRC Press, 1997
- [24] Katsaggelos A.K., Iterative Image Restoration Algorithms, Digital Signal Processing Handbook, CRC Press LLC, 1999.
- [25] Kongqiao Wang, Yanming Zou and Hao Wang, Bar code reading from images captured by

- camera phones, 2005 2nd International Conference on Mobile Technology, Applications and Systems. 15-17 Nov. 2005.
- [26] Kongqiao Wang, Yanming Zou, and Hao Wang, Bar code reading from images captured by camera phones, IEE Mobility Conference 2005. The Second International Conference on Mobile Technology, Applications and Systems.
- [27] L. Lucchese Yz and S. K. Mitra Y, Color Image Segmentation: A State-of-the-Art Survey, Dept. of Electrical and Computer Eng., University of California, Santa Barbara; Dept. of Electronics and Informatics, University of Padua
- [28] L. Rudin, S. Osher, E. Fatemi, Nonlinear total variation based noise removal algorithms. *Physica D*, 60:259-268, 1992.
- [29] Lanitis, A., Taylor, C. J. and Cootes, T., Automatic Interpretation and Coding of Face Images using Flexible Models, *IEEE Trans. PAMI*, 19(7), pp. 743-755, 1997.
- [30] M. Bertero and P. Boccacci, *Introduction to Inverse Problems in Imaging*, Taylor & Francis, 1998.
- [31] M. Rothenberg, A new inverse-filtering technique for deriving the glottal air flow waveform during voicing, *The Journal of the Acoustical Society of America*, 1972.
- [32] Mark S. Nixon, Alberto S. Aguado, *Feature Extraction and Image Processing*, Academic Press, Elsevier, 2008.
- [33] Milan S., Vaclav H., Roger B., *Image Processing: Analysis and Machine Vision*, CL-Engineering, 1998.
- [34] Muniz, R. Junco, L. Otero, A, A robust software barcode reader using the Hough transform, *Information Intelligence and Systems*, 1999.
- [35] Ning Zhong Liu, Han Sun, Deconvolution of the two-dimensional bar code based on binary constraint, *International Conference on Computer Science and Software Engineering*, 2008.
- [36] Ohbuchi E., Hanaizumi H., and Hock L.A., Barcode readers using the camera device in mobile phones, *Cyberworlds, International Conference*, 2004.
- [37] Pavel Berkhin, *A Survey of Clustering Data Mining Techniques*, 2006
- [38] Prewitt, J. M. S. and Mendelsohn, M. L., The Analysis of Cell Images, *Ann. N. Y. Acad. Sci.*, 128, pp. 1035-1053, 1966
- [39] Rafael C. Gonzalez, Michael G. Ibomason, *Syntactic Pattern Recognition An Introduction*,

Addison-Wesley, June 1978.

- [40] Rejean P. and Sargur N. S., On-Line and Off-Line Handwriting Recognition: A Comprehensive Survey, IEEE Transactions on Pattern Analysis and Machine Intelligence, 2000.
- [41] Richard O. Duda, Peter E. Hart, David G. Stork, Pattern classification, 2nd edition, Wiley, New York, ISBN 0-471-05669-3, 2001.
- [42] Roger C. P., The Bar Code Book: Reading, Printing, and Specification of Bar Code Symbols, Helmers Publishing, 1995.
- [43] S. C. Park, M. K. Park, and M. G. Kang., Super-resolution image reconstruction: a technical overview, IEEE Signal Processing Magazine, 20(3):21-36, May 2003.
- [44] S. Farsiu, D. Robinson, M. Elad, and P. Milanfar. Advances and Challenges in Super-Resolution, International Journal of Imaging Systems and Technology, Volume 14, no 2, pp. 47-57, August 2004.
- [45] S. Kresjic Juric, D. Madej, Madej Santosa, Applications of hidden Markov models in bar code decoding, Pattern Recognition Letters, Volume 27 Issue 14, 15 October 2006.
- [46] Selim Esedoglu, Blind Deconvolution of Bar Code Signals, Inverse Problems 20, 2004.
- [47] Shigeo Abe, Support Vector Machines for Pattern Classification, Springer-Verlag, 2005.
- [48] Singh, A. and Shneier, M., Gray level corner detection a generalization and a robust real time implementation, Comput. Vision Graph. Image Process., vol. 51, no. 1, pp. 54-69, July 1990.
- [49] Ender T. and James C., A Bayesian Algorithm for Reading 1D Barcodes, Computer and Robot Vision, 2009. CRV '09. Canadian Conference, May 2009.
- [50] Timothy J. Holmes, Maximum-likelihood image restoration adapted for noncoherent optical imaging, J. Opt. Soc. Am. A 5, 666-673 (1988)
- [51] Tinku A. and Ajoy K. R., Image Processing: Principles and Applications, Wiley, 2005
- [52] Tsai, D.-M., Hou, H.-T., and Su, H.-J., Boundary-based corner detection using eigenvalues of covariance matrices, Pattern Recognit. Lett., vol. 20, no. 1, pp. 3140, Jan. 1999.
- [53] Turin, W. and Boie, R.A., Bar code recovery via the EM algorithm, Signal Processing, IEEE Transactions, 2002.

- [54] Wiener Norbert, Extrapolation, Interpolation, and Smoothing of Stationary Time Series. New York: Wiley. ISBN 0-262-73005-7, 1949.
- [55] William K. Pratt, Digital Image Processing 4th.Ed, Wiley publisher, 2007.
- [56] Xianyong Fang, Fuli Wu, Bin Luo, Haifeng Zhao, Peng Wang, Automatic Recognition of Noisy Code-39 Barcode, Artificial Reality and Telexistence- Workshops, 2006. ICAT '06. 16th International Conference, 2006.
- [57] Zheng, Z., Wang, H., and Teoh, E., Analysis of gray level corner detection, Pattern Recognit. Lett., vol. 20, no. 2, pp. 149-162, Feb. 1999. REFERENCES 305.
- [58] Horst B. and Alberto S., Syntactic and Structural Pattern Recognition Theory and Applications: Theory and Applications, World Scientific Pub Co Inc, 1990.
- [59] Wang K., Zou Y., Wang H., 1D bar code reading on camera phones, International Journal of Image and Graphics. Vol. 7, no. 3, pp. 529-550. July 2007.