Blood Cell Segmentation Using Matlab Nuclei, Cell Counting, Splitting Cell, SBF, LCF cell image processing

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Abstract:
Blood cell segmentation is hot topic in medical field, using blood cell segmentation identify the disease and infected blood cells, sometime the white blood cell growth is low and Red blood cell growth rate is higher using image segmentation of MatLab tool is useful tool to identify different scenarios of blood cell counting using nuclei segmentation to identify cancer disease, heart disease, and different diseases. Image processing using different Laplacian Gauss filter, SBF Filter, LOG Filter and different filter of MatLab is useful to segment and classify image. Microscopy image of blood cell is first read in RGB and grayscale and after converting in binary scale and different classification to avoid blood cells image counting. Segmentation of partially overlapping objects with a known shape is needed in an increasing amount of various machine vision applications. This paper presents a method for segmentation of clustered partially overlapping objects with a shape that can be approximated using an ellipse

Keywords: Matlab, Image Segmentation SBF LOG, Gauss Filter, Nuclei Segmentation, Blood cell classification.

Introduction:
Image segmentation is old topic but in these blood cell image segmentation is widely used in medical field, many researcher and scientist have done lot of framework using blood cell microscopic image. Basically blood cell image segmentation used to detect no of white blood cells & red blood cells and infected both cells. Blood cells detection described the basic strategies to detect different symptoms and diseases in human body. Matlab is good tool to used image cell segmentation. For the development nuclei detection image enhancement is used through filtering of image, the locations of connected blood cells nuclei has been strong. Nuclei segmentation is associated the locations of maxima filter to obtain 2D and 3D detection of the image we can use fluorescence analysis. [1]

2D Cell Nuclei Detection

Blood cell connected and overlapped with each other image segmentation approach is good to use for segments each blood cells. If the blood cells connected strongly with each other the 3D segmentation approach is also good to use. Cell detection finding approach basically it depends on characteristics of the cells convergence index filter can detect convex shapes of the cells. [2]

Fluorescence symmetry based correction

3D nuclei cell detection we can analyze the segmented image to observe the fluorescence 3D fluorescence can remove the overlapped shape detection of the blood cells.
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Related Work

M. Y. Mashor et. al.[3] uses two processing methods. In their part one they enhance region of interest by using contrast enhancement technique on leukemia images and in part second they use image segmentation on HIS color space. Monica Madhukar et. al.[4] presents microscopic images are exposed to correlation of color, contrast enhancement and apply K-means clustering to the resultant images, by using this method they extracting nucleus
of the WBC. Fabio Scotti[5] also uses the same techniques for enhance microscopic image by eliminating background image, then use fuzzy k-means clustering for segmenting
the image.

Gray Conversion

RGB image to gray scale conversion using MatLab tool made easy, because image classification algorithm is implement on grayscale image.

Binary Conversion

From grayscale to Binary conversion using MatLab is also made easy binary image is basically describe the connectivity and overlapping features of the image, and it also describe the foreground and background pixel density of the image.

Median Filter and Normalization

Median filter replace the value of each pixel and its density this process is selected neighborhood region of the pixel. Normalized the pic using the x1, y1 position of the image make sure the image size and quality.

K- Means Clustering

Clustering seems to be a multi-dimensional grouping set the data by comparing similarity or dissimilarity values. Here we use the method of partition clustering, partitioning A given sample has a K cluster, features in the feature Sample groups are very similar to each other to those features in different sample groups. In the K-means clustering scheme, with the sum within the cluster Use changes in a given cluster. Inside the group the change is only the sum of the Euclidean squares. The distance between the sample and the cluster center. If the cluster is computationally very efficient good separation and compactness are satisfactory result.

Dorini, Rodrigo Minetto, et. Al.[6], practices two method of segmentation Level set and watershed transform. To segment nuclei they use SMMT operator and identify cytoplasm by granulometric analysis and morphological transformation.

Baidya Nath shah et. al.[7], practices outlier trace by analysis of principal component (PCA), automate active contour (snakes) for object detection. They trace snakes run on an image for detecting white blood cell nuclei. S. Mohapatra et.al.[8], uses a color segmentation process in two stage based on fuzzy to obtaining WBC from the other blood cells. For classifying nucleus they use Hausddorff dimension and contour signature.

J. Puttmade proposes a combined effect of K-means and Gram Schmidt orthogonolization process. He proposes K- means clustering based method using WBC (white blood cell) detection to segments each white blood cells using AND operation and the method is very simple and easy to implement. [9]

Consider the Bayesian classifier obtained by calculation A priori probability from the proportion of numbers Cells in the training set may not be feasible because Actually, I don't know the number of cells in each class. Advance. From our results, Bayesian and neural networks Classifiers tend to have a large number of classes Training samples. Classification rate improved When all categories are assumed to be equally possible. Extensive experiments have been carried out on neural networks. We initially trained the neural network by setting the required output. The tag class is 0.9, and the other classes are 0.1.[18]

Deep learning methods have been used to detect Cells in cancer biology. A method of mitosis detection [19] Perform data aggregation based on deep learning By using a convolutional neural network (CNN) Crowd layer (AggNet). Mualla et al. [20] propose a Automatic cell detection method on a polypropylene substrate, Suitable for microbeam irradiation. Harris corner detector is For detecting significant cellular characteristics.

These special characters Grouping based on double clustering technology According to their distribution density on the image. Then extract the weighted centroid from the cluster the corners form the target of the illumination. Qu el has Wait. [21] Introduced a new method of cell detection Shape estimation to detect overall convexity in multivariate an image based on a sliding band filter (SBF). In addition, the parameters involved are intuitive as they are direct It is related to the expected cell size. Use SBF filter, cell the nucleus, the location and shape of the cytoplasm were detected. In In the rest of this article, we will refer to the term "cell" Interchangeable with GFP core (as our target) Detection / segmentation).

Watershed transformation is a Common methods used in overlapping cell division [22], [23], [24]. Use a certain strategy Initialization, such as morphological filtering [25] or Adaptive H-minima transform [26], watershed transform May overcome over segmentation problems
Used to split the overlapping objects. Method basis Difficulties about watershed transformation Split highly overlapping objects, which are powerful Gradient does not exist.

Local Convergence Filter
By assuming the shape of the bump and the limited size range in the nuclear region, we can use LCF for nuclear detection. And shape estimation. This is possible because of LCF detection Local gradient convergence in an image is usually an indication of the convex shape is characteristic of most nuclei. Further discussion of the extent of the relationship Gradient convergence and bulging of the shape the image can be found in [27].

Phase- Based SBF
Although the definition of the image amplitude derivative is poor Contrast area, image phase information can be used for extraction Meaningful information about edge direction and intensity [28]. This phase information provides greater robustness at low levels Contrast to promote the development of some people Phase-based edge measurement [29, 30, 31]. Phase consistency (PC), also known as phase coherence, Method tries to find the position of all sinusoids in the image It is in phase in the frequency domain. These locations Usually corresponds to the location of the perceived edge, Whether the edge is represented by a large or Small changes in the strength of the spatial domain [32]. therefore, Can then be a fixed threshold of feature importance Use under a wide range of imaging conditions [33, 34]. PC is a directional measurement method

Classification

Segmentation
Blood Cell image segmentation using clustering algorithm k mean algorithm and SVM MatLab algorithm is good algorithm to cluster and classify image in more descriptive order.
Morphological Operation
This operation is basically used in binary image, basically this image is best way to segment in further position.
Feature Extraction
Feature Extraction of morphological image is designed to extract each pixel information of blood cell all blood cells segments and overlapping with each other, feature extraction is classify the segmented image in more sophisticated order.

Methodology:
Our method of cell detection in multivariate microscopy images Based on local image filtering using an SBF filter. Such as Most of the previous work on multivariate cell segmentation, we will processing nuclear and cytoplasmic information separately in the initial phase Steps, starting with detecting potential cores.
From detection Nuclei we estimate the cytoplasmic shape of the cells, followed by Images related to the nucleus and cytoplasm the shape estimate only shows the corresponding fluorescent channel. Regularization by overlap correction and shape. Nuclear testing is only considered final if there is sufficient evidence to prove effective Corresponding cytoplasmic detection. We take the task of nuclear segmentation as one of them. Partial image enhancement through filtering, where the position corresponds the nucleus will produce a strong filtration reaction. Subsequently, the nucleus is temporarily associated with the location Filter maximum response. [10]

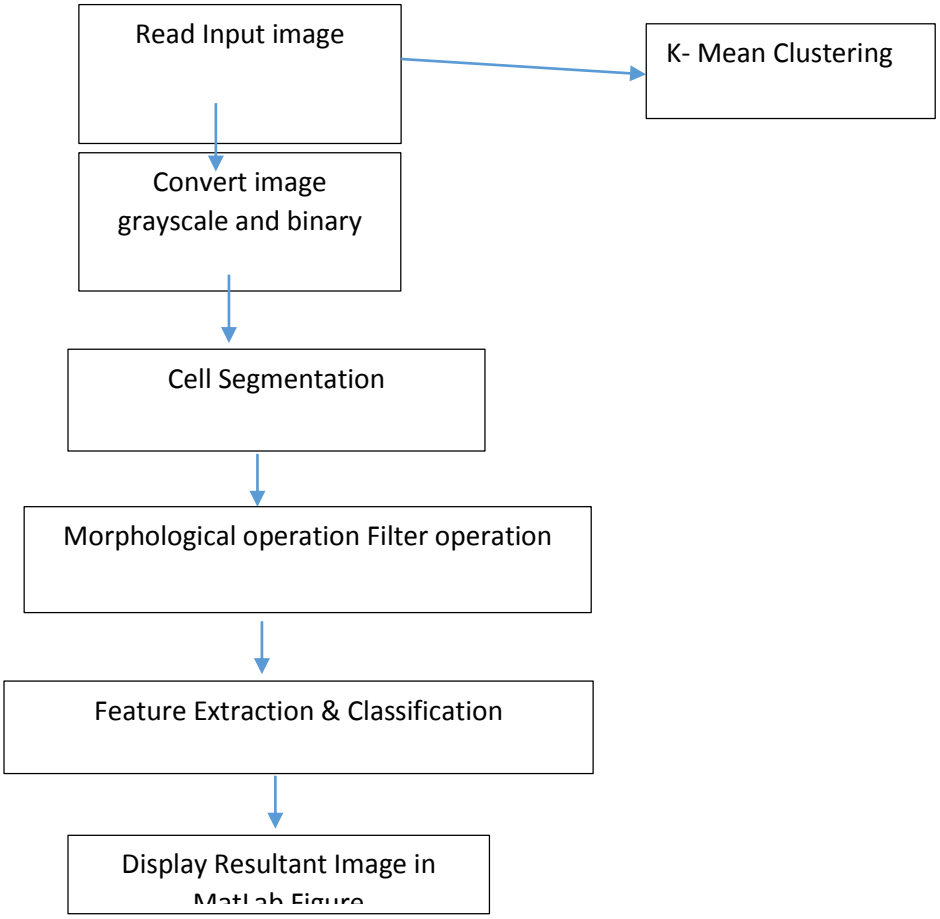
The classic method of nuclear segmentation is usually based on the intensity threshold method [11], [12], [13]. The simple way to use this splitting task is sometimes, overall good spatial separation is reasonable. Nuclei and relatively high contrast. But most people the solution requires a lot of pre-processing steps. In order to overcome irregular lighting, channels and other issues Crosstalk and noise, [14]. Our nuclear detection method is based on highlighting Display image locations that represent features that exist a core, through partial filtering. Because the nucleus has Integral convex shape, filter from convergence exponential filter Family was selected to perform this enhanced task.

Instead, the proposed method based on local detection by using SBF gradient convergence filter. For cell detection, we collect evidence from it Co-detection and verification of nuclear and cytoplasmic fluorescence the location of the cells and their shape are estimated. Use Suppose the cell's cytoplasmic convergence center is approximate Same as the corresponding core convergence Center we can better guide cytoplasmic testing The location of the nucleus. Since SBF is based on convergence Method is robust to contrast changes, making it interesting
A tool for microscopic fluorescence image analysis. In addition, has the advantage of relying on intuitive parameters regarding the physical properties of the imaged cells. This method of cell detection is

essentially universal Based solely on the principle of cell convexity. Cell detection The problem solved here is some of the most challenging issues. In the current multivariate microscope image analysis. In this way, we I believe it can be applied to other problems of multivariate cell division [15].

Segmentation:
The blood sample image is segmented using a clustering algorithm. We use adaptive k-means clustering. Algorithm [16] is used for segmentation. The algorithm can be applied to both color and gray images. It is based on k-means clustering with the following disadvantages. 1) Predetermine the number of clusters or A K value may raise an empty cluster for a higher value. 2) It is slow and does not perform well in time. 3) It may find worse local optima and 4) different initial partitions may lead to different final clusters, which leads to the output to the same image is inconsistent. In this article, we use the adaptive K-means algorithm to find Cluster. The algorithm is adaptive in nature and proceeds as follows: Start by randomly selecting K initial seeds from the input image. These random K elements form seeds the cluster and each element that owns them also constitute the properties of the cluster.

This function uses the Euclidean distance from the centroid to quantify the distance between two objects. If the distance is within the threshold, the element is merged into the nearest cluster through the centroid May change. In addition, the distance of the affected cluster from other clusters and the minimum distance between any two clusters and the two clusters closest to each other. Based on Distance clustering is complete. Repeat these steps until all the elements have gathered. When all elements in the input are clustered, the algorithm stops[17]



Results

Figure 1:

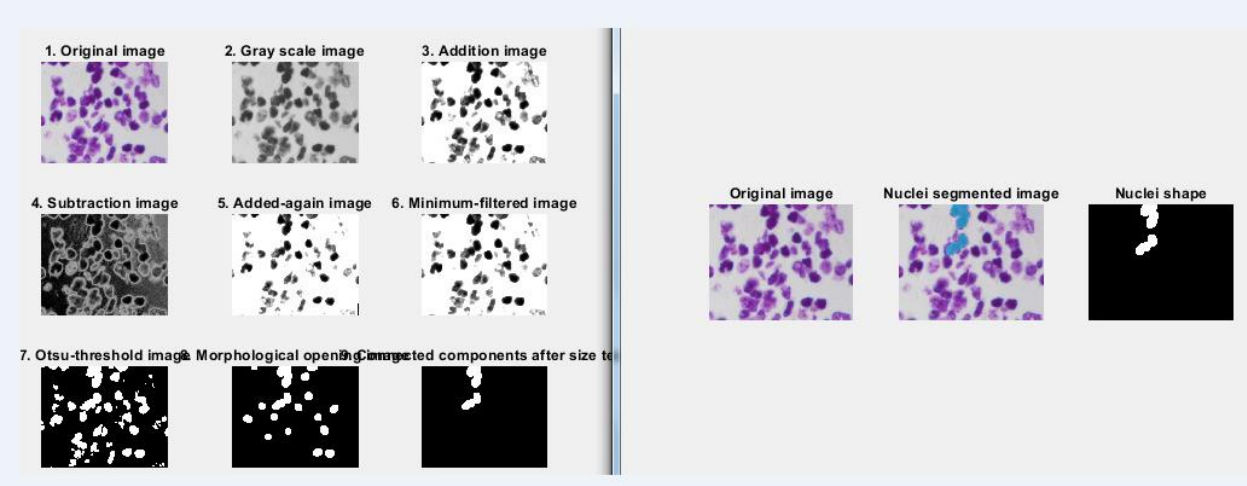


Figure 2:

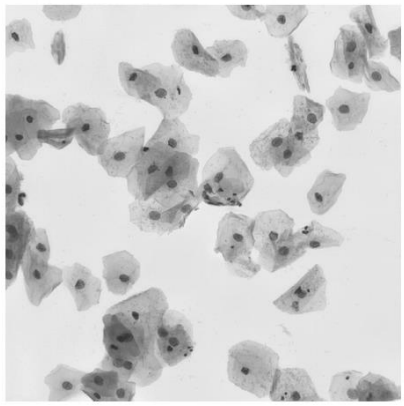


Figure 3:

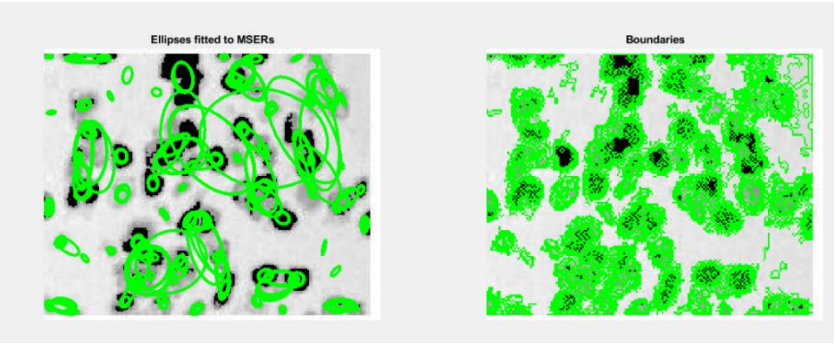
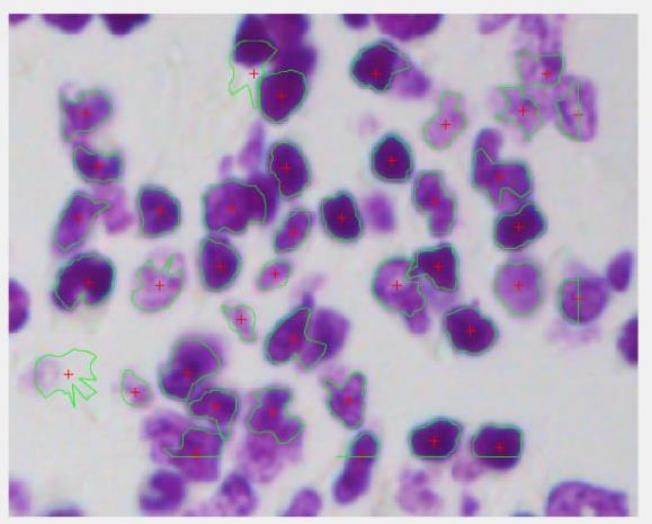


Figure 4:
Using SBF Filter final image classification



Conclusion

We proposed Sliding Band filter, Laplacian of gauss filter method, LCF and gradient convergence is also used, blood cell image segmentation watershed method mostly used in previous the best method is SBF filter to detect each blood cell separately. Blood cell shape estimation SBF and LCF method is good to used. For future research we proposed neural network deep learning method to classify image using different blood cell image data to segments and identify the symptoms in the blood samples. With the help of deep learning and CNN network is the best way to segment and separate each blood cell for identification and development of different results, but in this case blood sample is requires for same blood group not for different blood group members.

References

[1] Pedro Quelhas1, Ana Maria Mendonc¸a1;2, Aur´elio Campilho1;2 1INEB - Instituto de Engenharia Biom´edica, Divis˜ao de Sinal e Imagem 3D Cell Nuclei Fluorescence Quantification Using Sliding Band Filter.

[2] X. Chen, X. Zhou, and S. T. C. Wong, “Automated segmentation, classification, and tracking of cancer cell nuclei.

[3]. Aimi Salihah, Mashor MY, Harun NH, Rosaline H. Improving colour Image Segmentation on Acute Myelogenous Leukemia using Contrast Enhancement Techniques. Kuala Lumpur: IEEE EMBS conference on Biomedical Engineering and Sciences. 2010; p. 246-51.

[4] Monica Madhukar, Agaian S, Antony TC. Deterministic model for Acute Myelogenous Leukemia Classification. Seoul, Korea: IEEE International conference on systems, man and Cybermetics. 2012; p. 433-8.

[5] Fabio Scotti. Robust Segmentation and Measurements Techniques of white cells in Blood Microscopic Images. Italy: IEEE, IMTC 2006 Instrumentation and Measurement Technology Conference. 2006; p. 43-8.

[6] Leyza Baldo Dorini, Rodrigo Minetto and Leite NJ. Semiautomatic White blood cell segmentation Based on multiscale analysis. IEEE Journal of Biomedical and Health Informatics. 2013 January; 17(1):250-7.

[7] Baidyanath Shah, Nilanjan Ray and Hong Zhang. Snake Validation: A PCA Based outlier detection method. IEEE Signal Processing Letters. 2009 June; 16(6):549-53.

[8] Mohapatra S, Samanta SS and Dipti Patra. Fuzzy based Blood image segmentation for automated leukemia detection' IEEE. 2011.

[9] J. Puttmade Gowda1 and S. C. Prasanna Kumar Segmentation of White Blood Cell using K Means and Gram-Schmidt Orthogonalization

[10] Pedro Quelhas*, *Member, IEEE*, Monica Marcuzzo IEEE transaction Journal Medical August 2011. Cell Nuclei and Cytoplasm Joint Segmentation Using the Sliding Band Filter

[11] N. Harder, F. M-Bermudez, W. Godinez, J. Ellenberg, R. Eils, and K. Rohr, "Automated analysis of mitotic cell nuclei in 3-D fluorescence microscopy image sequences," in*Workshop Bio-Image Inf.: Biol. Imag., Comput. Vis. Data Mining*, Santa Barbara, CA, 2008, pp. 17–18.

[12] A. Hill, P. LaPan, Y. Li, and S. Haney, "Impact of image segmentation on high-content screening data quality for sk-br-3 cells," *BMC Bioinformatics*, vol. 8, no. 340, pp. 1–13, 2007.

[13] T. R. Jones, A. Carpenter, and P. Golland, "Voronoi-based segmentation of cells on image manifolds," in *ICCV Workshop Comput. Vis. Biomed. Image Appl. (CVBIA)*, 2005, pp. 535–543.

[14] G. Xiong, X. Zhou, L. Ji, P. Bradley, N. Perrimon, and S.Wong, "Segmentation of drosophila RNAI fluorescence images using level sets," in *Proc. IEEE Int. Conf. Image Process.*, 2006, pp. 73–76.

[15] Pedro Quelhas*, *Member, IEEE*, Monica Marcuzzo. IEEE TRANSACTIONS ON MEDICAL IMAGING, VOL. 29, NO. 8, AUGUST 2010 1463 Cell Nuclei and Cytoplasm Joint Segmentation Using the Sliding Band Filter.

[16] Arjun Nelikanti, Narasimha LV Prasad, and Naresh M. Goud. "Colorectal Cancer MRI Image Segmentation Using Image Processing Techniques."International Journal on Computer Science and Engineering 6.7 (2014): 280.

[17] Arjun Nelikanti / Indian Journal of Computer Science and Engineering (IJCSE) Segmentation and Analysis of Cancer Cells in Blood Samples Arjun Nelikanti.

[18] Nipon Theera-Umpon*, Senior Member, IEEE*, IEEE TRANSACTIONS ON INFORMATION TECHNOLOGY IN BIOMEDICINE, VOL. 11, NO. 3, MAY 2007 Morphological Granulometric Features of Nucleus in Automatic Bone Marrow White Blood Cell Classification

[19] S. Albarqouni, C. Baur, F. Achilles, V. Belagiannis, S. Demirci, and N. Navab. Aggnet: deep learning from crowds for mitosis detection in breast cancer histology images. IEEE Transactions on Medical Imaging, 35(5):1313–1321, 2016.

[20] F. Mualla, S. Schöll, B. Sommerfeldt, A. Maier, and J. Hornegger. Automatic cell detection in bright-field microscope images using SIFT, random forests, and hierarchical clustering. IEEE Transactions on Medical Imaging, 32(12):2274–2286, 2013.

[21] P. Quelhas, M. Marcuzzo, A. M. Mendonça, and A. Campilho. Cell nuclei and cytoplasm joint segmentation using the sliding band filter. IEEE Transactions on Medical Imaging, 29(8):1463–1473, 2010.

[22] J. Shu, H. Fu, G. Qiu, P. Kaye, and M. Ilyas, "Segmenting overlapping cell nuclei in digital histopathology images," in *Proc. 35th Annu. Int. Conf. Eng. Med. Biol. Soc. (EMBC)*, Jul. 2013, pp. 5445–5448.

[23] B. Parvin, Q. Yang, J. Han, H. Chang, B. Rydberg, and M. H. Barcellos-Hoff, "Iterative voting for inference of structural saliency and characterization of subcellular events," *IEEE Trans. Med. Imag.*, vol. 16, no. 3, pp. 615–623, Mar. 2007.

[24] J. Cheng and J. C. Rajapakse, "Segmentation of clustered nuclei with shape markers and marking function," *IEEE Trans. Biomed. Eng.*, vol. 56, no. 3, pp. 741–748, Mar. 2009.

[25] C. Jung and C. Kim, "Segmenting clustered nuclei using *H*-minima transform-based marker extraction and contour parameterization," *IEEE Trans. Biomed. Eng.*, vol. 57, no. 10, pp. 2600–2604, Oct. 2010.

[26] Y. Al-Kofahi, W. Lassoued, W. Lee, and B. Roysam, "Improved automatic detection and segmentation of cell nuclei in histopathology images," *IEEE Trans. Biomed. Eng.*, vol. 57, no. 4, pp. 841–852, Apr. 2010.

[27] Kobatake, H., Hashimoto, S.: Convergence index filter for vector fields. IEEE Trans. Image Process. 8(8), 1029–1038 (1999)

28]. Kovesi, P.: Image features from phase congruency. In: Videre, pp. 1–26 (1999)

[29] Kovesi, P.: Phase congruency detects corners and edges. In: Digital Image Computing: Techniques and Applications, pp. 309–318 (2003)

[30]. Kube, P.: Properties of energy edge detectors. In: IEEE Conference on ComputerVision and Pattern Recognition (CVPR), pp. 586–591 (1992)

[31]. Leibe, B., Leonardis, A., Schiele, B.: Combined object categorization and segmentation with an implicit shape model. In: ECCV Workshop on Statistical Learning in Computer Vision, pp. 17–32 (2004)

[32]. Morrone, M., Burr, D.: Feature detection in human vision: a phase-dependent energy model. Proc. Roy. Soc. Lond. B Biol. Sci. 235(1280), 221–245 (1988)

[33]. Wei, J., Hagihara, Y., Kobatake, H.: Edge detection and skeletonization using quantized localized phase. In: European Signal Processing Conference (EUSIPCO), pp. 1542–1546 (2009)

[34] Kobatake, H., Hashimoto, S.: Convergence index filter for vector fields. IEEE Trans. Image Process. 8(8), 1029–1038 (1999)