Subgrain Edge Detection on Images of Steel 2,25Cr-1Mo Using Watershed Method

Iryna Ivasenko, Roman Vorobel

Abstract – **Method of preliminary image processing based on retinex theory for subgrain edge detection of steel 2,25Cr-1Mo using watershed approach is proposed. Experimental results are presented to demonstrate the effectiveness of proposed approach.**

Keywords - **Retinex theory, Watershed Method, Image processing.**

I. INTRODUCTION

Object detection is one of the most complex image processing problems. Watershed method is often used for solving this problem. A gray scale image is interpreted as the topographic image of landscape. Watershed method classifies pixels according to their spatial proximity, the gradient of their gray levels and the homogeneity of their textures. In the case of subgrain edge detection of steel 2,25Cr-1Mo images this method needs preliminary processing. We propose to use retinex based smoothing and robust image filtering algorithm based on the outlier localization.

II. INSTRUCTION FOR AUTHORS

To enhance image we apply illumination equalization. It compensates non-uniform distribution of illumination component and increases local contrast. For this purpose is used method [1], that is a superposition of single-scale implementations of Retinex (SSR) [2] on the basis of local smoothing (Retinex is a theory of light perception by a human that has a physiological basis and uses the logarithmic nature of radiance fixation and its spatial relativity). SSR is defined by the expression

$$R(x,y) = \log I(x,y) - \log[F(x,y) * I(x,y)]$$

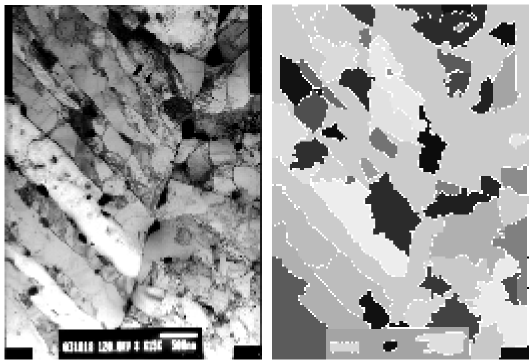
$$F(x,y) = K \cdot e^{-(x^2+y^2)/\sigma^2},$$

where $R(x,y)$ is a SSR output, $I(x,y)$ is input image, $F(x,y)$ is Gaussian neighbourhood function with normalizing constant K and spatial constant σ, which is the local standard deviation, and * is an operator of convolution. The optimal value of SSR levels is equal to 3. Spatial constants are chosen linearly in logarithmic scale, with top value equal to the one sixth part of the image size. Histograms of each SSR are brought to the form that corresponds to the normal distribution with mathematical expectation equal to the mean of gray level range of LMAX pixel and standard deviation $\sigma = LMAX/6$. As the value of spatial constant of neighbourhood function is inversely proportional to the quality of image frequency transmission so for every SSR level is formed weighted spatial-frequential image $EM(x,y)$.

$$EM(x,y) = F(x,y) * Edge[\log I(x,y)],$$

where $Edge[\cdot]$ is the edge detection operator (Sobel operator). In the case of overdetalization of the input image the correction is made by the weight coefficients of SSR superposition that follows from the statement of spatial dependence of the spatial constant of neighbourhood function from the quality of frequency transmission by appropriate SSR.

The next step is the application of robust image filtering algorithm based on the outlier localization [3] and marker-based image segmentation with watershed transformation [4]. The results of edge detection are presented on Fig. 1.



a) b)

Fig. 1 Steel image (a) and result of subgrain edge detection (b)

III. CONCLUSION

Proposed method detects homogeneous by intensity subgrains but in case of complex subgrains needs interactive correction.

REFERENCES

[1] Botsian V.V. Enhancement of the approaches to the retinex applications. XXII open young scientist conference of Karpenko Physico-mechanical institute, Lviv, October 26-28, 2011, . P. – 225-228 (ukr).

[2] Jobson D.J., Rahman Z., Woodell G.A. Properties and performance of a center/surround retinex. IEEE Transaction on Image Processing. – 1997. – Vol.6. – No 3. – P. 451-462.

[3] Ivasenko I.B. Robust image filtering algorithm based on the outlier localization. Information extraction and processing # 19(95) - 2003 - P. 102-106 (ukr).

[4] Moga A. N., Gabbouj M., "Parallel marker-based image segmentation with watershed transformation", Journal of Parallel and Distributed Computing 51, 27{45), 1, 1998.

Iryna Ivasenko – Karpenko Physico-Mechanical Institute of NASU
5 Naukova St., Lviv, 79060 Ukraine
E-mail: ivasenko@ipm.lviv.ua
Roman Vorobel – Karpenko Physico-Mechanical Institute of NASU
5 Naukova St., Lviv, 79060 Ukraine
E-mail: vorobel@ipm.lviv.ua