Composing of skeletons of 2D images and analysis of scanning-probe-microscopy data

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This lecture is devoted to the composing of skeletons of two-dimensional (2D) halftone images for further analysis. The introductory part of the lecture is aiming to meet audience with a powerful technique of skeletonization [1]. The skeleton is a combination of one-pixel-wide lines (continuous or broken) which reproduce topology and peculiar shapes of an original halftone image. In order to plot a skeleton for given image one can use built-in functions (for example, in the programming languages Matlab and Python), or compose independently considering cross-sectional views line-be-line. The latter case is applicable even for noisy images with pronounced gradient of contrast. The skeleton can be used for automatic determination of peculiar points like branching and end points (see Fig. 1). To illustrate capability of this approach we consider problems of determination of edges of atomically-flat terraces, screw dislocations, fingerprint identification etc. The original part of the lecture is devoted to numerical analysis of motion of topological defects for a series of noisy images acquired by magnetic-force microscopy for $EuFe_2(As_{1-x}P_x)_2$ single crystals [2].

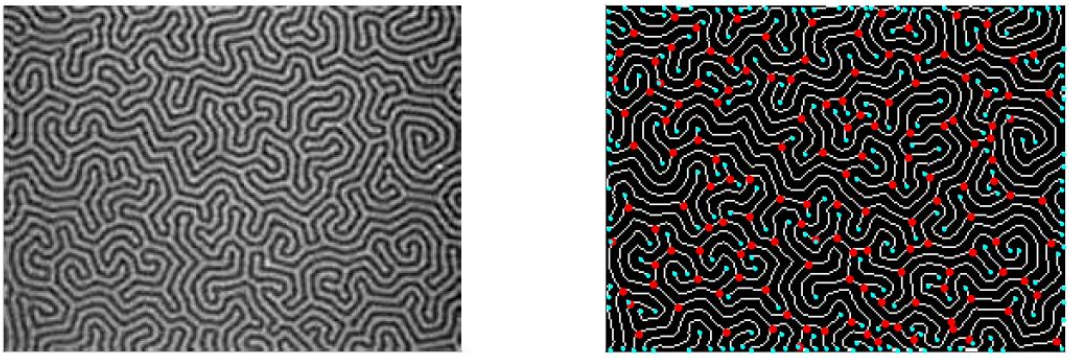

Fig.1. Left panel – magneto-optical halftone image of magnetic domain structure in a YIG thin film (Wang, Shang, Wu, Yang and Ji, Chin. Phys. Lett., vol. 33, 047502 (2016)). Right panel – a skeleton of the image (white lines), branching points (red dots), and end points (cyan dots) prepared using built-in Matlab functions [1].

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Bibliography

[1] R. C. Gonzalez, R. E. Woods and S. L. Eddins, Digital Image Processing Using MATLAB. 2nd ed., Tata McGraw Hill Education Private Limited. New Delhi (2010).
[2] A. Vagov, S. Köstler, T. T. Saraiva, A. Yu. Aladyshkin, D. Y. Roditchev, A. A. Shanenko, and V. S. Stolyarov, unpublished.