

Modern state of optical microscopy

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The paper analyzes the modern widespread microscopy techniques as wide-field, laser scanning confocal and structured illumination microscopy.

Wide-field microscopy is a technique, which provides fast imaging capture because all the field of view is illuminated uniformly. However, this technique has limitation in capturing 3D images using the software for digital focus extension. It also requires powerful light sources that can damage biological specimens.

Laser scanning confocal microscopy (LSCM) still remains the best choice due to the high lateral and axial spatial resolution. The modern LSCM allows observation with white light illumination, registration of 3D images in several spectral ranges and with multi-channel photodetectors. The principal limitation factor of LSCM is a high price – the typical models cost from 100K up to 2000K Euros. Some models with low resolution have price in range 50K– 80K Euros.

Structured illumination microscopy (SIM) can be considered as an economical alternative of LSCM. It allows capturing color 3D digital images with high axial and lateral spatial resolution. The principal advantages is possibility to update wide-field microscope with a motorized focus driver by a SIM slider. As a result, the price of a microscope for capturing 3D images becomes smaller 40K – 50K Euros. The other advantages is ability to create 2D and 3D periodical or stochastic patterns of structural illumination to reach the 2-folds superresolution in 2D and 3D spaces. The disadvantages of SIM are image distortions caused by formation or projection of 2D and 3D periodical or stochastic patterns in object spaces. It requires special image processing for restoration of images with the patterns on them.

Summarizing said above we conclude that SIM, in particular – updating the existing optical microscopes with economical SIM sliders, has good perspectives for Ukrainian laboratories. Such SIM makes possible 3D image capturing without spending big money for purchasing LSCM instruments.

Key words: wide-field microscopy, laser scanning confocal microscopy, structured illumination microscopy, spatial resolution

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Topics

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