EXPANDING THE CAPABILITIES OF MULTIFOCUS MICROSCOPY (MFM)

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Multifocus microscopy (MFM) is an imaging method that enables researchers to study quickly moving living samples over extended 3D volumes [1]. Diffractive Fourier optics is used to create an instant focal series of 2D wide-field images arranged in an array and recorded in a single camera frame (Fig. 1). In this way, the entire imaging volume is recorded simultaneously and no mechanical movement is required. Acquisition speed is limited by exposure time and the camera readout-rate for a single frame. A specially designed optical module corrects for the chromatic dispersion introduced by the multifocus grating, allowing us to use this diffractive optics method to image light across the visible spectrum. Future developments of MFM include further improving the light-efficiency (sensitivity) of the system, and expanding the volume of view and number of sampled planes.

Figure 1: MFM system. The multi-focus grating is placed in the Fourier plane and splits the emission light from the sample into a set of diffractive orders. A geometrical distortion in the grating introduces a phase-shift that is dependent on diffractive order. The phase shift is calibrated to remove the out-of-focus phase error of a specific plane z, creating an instant focal series. The chromatic dispersion is removed by a multi-panel, blazed chromatic correction grating combined with a multi-faceted prism.