Hexagonal SIM with phase gratings and coherent light
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We present an approach for 3D Structured Illumination, using 2D patterns with an hexagonal symmetry. The patterns have to be shifted in one lateral direction only, there is no pattern rotation necessary in order to obtain all phase images required to separate all frequency bands contained in the raw images.

As described in [1], the 0th and 1st order amplitude frequency orders will transmit through the objective pupil. In case of an hexagonal pattern, this leads to 19 frequency orders in the intensity spectrum, employing six different directions in frequency space.

Our 2D SIM approach is furthermore combined with line confocal microscopy, where the laser line is scanned over a phase grating and the rolling shutter of the camera is synchronized with the line.

Compared to classical line grid SIM, our approach leads to a better S/N for frequencies outside the classical OTF support and a less anisotropic Power Spectral Density in the evaluated image, provided the excitation dose is equal in both modes. Furthermore, the line scanning leads to less out of focus light in the measured raw images and thus a better usability with thick samples.
