

## STED Microscopy with Speckles

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Super-resolution microscopy is an essential tool for biological imaging because it allows visualization of the sample at spatial scales beyond the diffraction limit. However, complex media such as biological tissues scatter light, which makes the observation of deeper tissue layers very challenging. Stimulated Emission Depletion (STED) microscopy is one of the most common implementations of super-resolution techniques [1] that achieves a lateral resolution of 50 nm. Among other super-resolution methods, STED microscopy allows the deepest observation into biological tissue, down to 100  $\mu\text{m}$ . Beyond this depth, light is scattered and transformed into a speckle pattern. Although speckle patterns can be considered as a loss of information, it has been shown that they can be used in optical imaging to recover object information after complex media such as biological samples [2]. In addition, speckles are perfectly suited to performing compressed imaging since they are statistically orthogonal (i.e., highly incoherent) with respect to the cross-correlation product. Moreover, thanks to the high density of optical vortices in the speckle patterns, we have shown that the fluorescence confinement under the diffraction limit can be achieved [3]. In a previous study, we have developed a three-dimensional super-resolution microscopy technique by saturating the fluorescence excitation with speckles [4]. Here, we present super-resolved, compressed 3D microscopy by saturating stimulated emission using complementary speckle patterns as excitation and depletion beam.

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