Acousto optic imaging beyond the acoustic diffraction limit using speckle decorrelation [1]

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Acousto-optic imaging (AOI) enables optical-contrast imaging deep inside scattering samples via localized ultrasound modulation of scattered light. However, the resolution in AOI is inherently limited by the ultrasound focus size, prohibiting microscopic investigations. In recent years advances in the field of digital wavefront-shaping allowed the development of novel approaches for overcoming AOI's acoustic resolution limit. However, these approaches require thousands of wavefront measurements within the sample speckle decorrelation time, limiting their application to static samples. Here, we show that it is possible to surpass the acoustic resolution-limit with a conventional AOI system by exploiting the natural dynamics of speckle decorrelations rather than trying to overcome them. We achieve this by adapting the principles of super-resolution optical fluctuations imaging (SOFI) to AOI. We show that naturally fluctuating optical speckle grains can serve in AOI as the analogues of blinking fluorophores in SOFI, enabling super-resolution by statistical analysis of fluctuating acousto-optic signals.

[1] Doktofsky, D., Rosenfeld, M. & Katz, O. Acousto optic imaging beyond the acoustic diffraction limit using speckle decorrelation. *Commun Phys* **3,** 5 (2020)