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Main areas of interest:

1) HiLo microscopy

This is a technique to provide out-of-focus background rejection to a standard fluorescence or reflection microscope. The technique requires the acquisition of two images, one a standard uniform illumination image, and the other a “structured” illumination image. An image processing algorithm then removes the out-of-focus background from the first image. HiLo microscopy is designed to compete with confocal microscopy. The benefits of HiLo microscopy are that it is inexpensive, simple to implement, and fast (half the camera frame rate). We are currently in the process of building a HiLo endomicroscope to assess its ability to perform in situ optical biopsies. We are also building a HiLo macroscope for ultra widefield imaging (1cm field of view) for small animal molecular imaging applications.

2) Two-photon excited fluorescence microscopy

TPEF microscopy is a scanning fluorescence microscopy technique similar to confocal microscopy. Its advantage over confocal is that it provides improved depth penetration in scattering tissue. Our lab possesses two homebuilt TPEF microscopes, one operation at 700nm-950nm excitation wavelength, and the other operation at 1050nm excitation wavelength. Features of these microscopes are that they provide high resolution imaging (1 μ m) over wide fields of view (1mm) with fast temporal resolution (50ms). We are currently using these microscopes to monitor Calcium dynamics in rat brain slices, and also perform second-harmonic generation imaging of collagen. Future directions of research are to improve depth penetration using adaptive optics, and implementing fluorescence lifetime imaging.