I will discuss our efforts to develop high resolution optical methods that are better suited for the study of live, dynamic, and 3D biological samples than conventional imaging tools. Structured illumination microscopy (SIM) doubles the spatial resolution of a light microscope, and requires lower light intensities and acquisition times than other super-resolution techniques, but has been mostly applied to the study of single cells. I will present alternative SIM implementations that permit resolution doubling in live volumes > 10x thicker than possible with conventional SIM, as well as hardware modifications that enable effectively ‘instant’ SIM imaging at rates 10-100x faster than other SIM implementations.

The second half of the talk will focus on the development of inverted selective plane illumination microscopy (iSPIM), and subsequent application to the noninvasive study of neurodevelopment in nematode embryos. Next, I will discuss progress that quadruples the axial resolution of iSPIM by utilizing a second specimen view, thus enabling imaging with isotropic spatial resolution (dual-view iSPIM, or diSPIM). Applications of this technology will be presented, including early efforts to computationally ‘untwist’ the growing worm embryo.