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Selective Plane Illumination Differential Dynamic Microscopy with Adaptive Optics DEVYNN WULSTEIN, RYAN MCGORTY, Department of Physics and Biophysics, University of San Diego — We measure the dynamics of colloidal particles and DNA molecules using differential dynamic microscopy (DDM) on images captured through selective-plane illumination microscopy (SPIM). Combining DDM, a digital Fourier microscopy method, and SPIM, an optical sectioning microscopy technique, we can analyze the dynamics of concentrated suspensions of colloids and biopolymers. Further, selective-plane illumination differential dynamic microscopy (SPIDDM) exploits the spatial variations of the Gaussian light-sheet to obtain diffusion data over a wide range of spatial frequencies. Presented work focuses on in vitro measurements of colloids, DNA molecules and cytoskeleton networks. We have measured the collective dynamics of DNA in actin and microtubule networks spanning an order of magnitude in spatial frequencies. This work could easily extend to living samples given SPIDDM's sparing use of excitation light. We are currently adding adaptive optics into our light-sheet microscope with a deformable mirror. We discuss using adaptive optics for multiple purposes. The mirror corrects optical aberrations due to the sample holder and the sample. We are also using adaptive optics to optimize the three-dimensional point spread function for DDM measurements. Using the deformable mirror to purposefully introduce known aberrations could allow for a more precise measurement of colloidal or molecular dynamics in three-dimensions.

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