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Characterizing the simulated anomalous diffusion of proteins in relation to the nanoporous structure of extracellular matrix-relevant hydrogels[1] SHAWN YOSHIDA, WILLIAM SCHMID, NAM VO, LYDIA KISLEY, Case Western Reserve University — Local drug delivery requires therapeutics to diffuse through the nanoporous structure of the extracellular matrix. To enable the efficient delivery of drugs, both the structure of this hydrogel environment and the diffusion of the drug must be understood. We simulated fluorescence microscopy data of BSA diffusing in binarized images of polyacrylamide at various concentrations. Conventional methods are unable to quantify both nanoscale structure and diffusion, but we were able to overcome these limitations with a correlation technique known as "fluorescence correlation spectroscopy super-resolution optical fluctuation imaging" or "fcsSOFI," which can quantify local anomaleity and diffusion coefficients, along with the size, shape, and frequency of nanopore structures. In conditions based on experimental sample and microscope parameters, we observed subdiffusive behavior of BSA in smaller pores. Delauney triangulation was applied to calculate pore sizes, and showed agreement with the ground truth. Combining the characterizations of pore sizes and local anomaleity allowed us to relate the subdiffusivity of simulated proteins with pore size. These findings can help inform drug-delivery applications where nanoparticle therapeutics must diffuse through the extracellular matrix.

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