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Two-dimensional confocal laser scanning microscopy image correlation for nanoparticle flow velocimetry BRIAN JUN, Purdue University, MATTHEW GIARRA, Virginia Tech, BRIAN GOLZ, RUSSELL MAIN, PAVLOS VLACHOS, Purdue University — We present a methodology to mitigate the major sources of error associated with two-dimensional confocal laser scanning microscopy (CLSM) images of nanoparticles flowing through a microfluidic channel. The correlation-based velocity measurements from CLSM images are subject to random error due to the Brownian motion of nanometer-sized tracer particles, and a bias error due to the formation of images by raster scanning. Here, we develop a novel ensemble phase correlation with dynamic optimal filter that maximizes the correlation strength, which diminishes the random error. In addition, we introduce an analytical model of CLSM measurement bias error correction due to two-dimensional image scanning of tracer particles. We tested our technique using both synthetic and experimental images of nanoparticles flowing through a microfluidic channel. We observed that our technique reduced the error by up to a factor of ten compared to ensemble standard cross correlation (SCC) for the images tested in the present work. Subsequently, we will assess our framework further, by interrogating nanoscale flow in the cell culture environment (transport within the lacunar-canalicular system) to demonstrate our ability to accurately resolve flow measurements in a biological system.

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