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**Precision Particle Characterization with Holographic Video Microscopy** MARK HANNEL, New York University, DAVID B. RUFFNER, Spheryx, Inc., JOHN C. CROCKER, University of Pennsylvania, DAVID G. GRIER, New York University — We previously have introduced methods for tracking and characterizing individual colloidal spheres through quantitative analysis of holographic video microscopy images. Here, we demonstrate that the performance of holographic particle characterization can be improved substantially by accounting properly for wavefront propagation through the microscope’s imaging system. This analysis provides new design criteria for the microscope that we have implemented using a Shack-Hartmann wavefront sensor. The improved measurement system achieves consistent precision and accuracy throughout a measurement volume extending to 100 micrometers on a side. Experiments on well-characterized model systems confirm this technique’s ability to track a micrometer-scale sphere to within 3 nanometers, while simultaneously measuring its radius with nanometer precision and its refractive index to within a part per thousand.

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