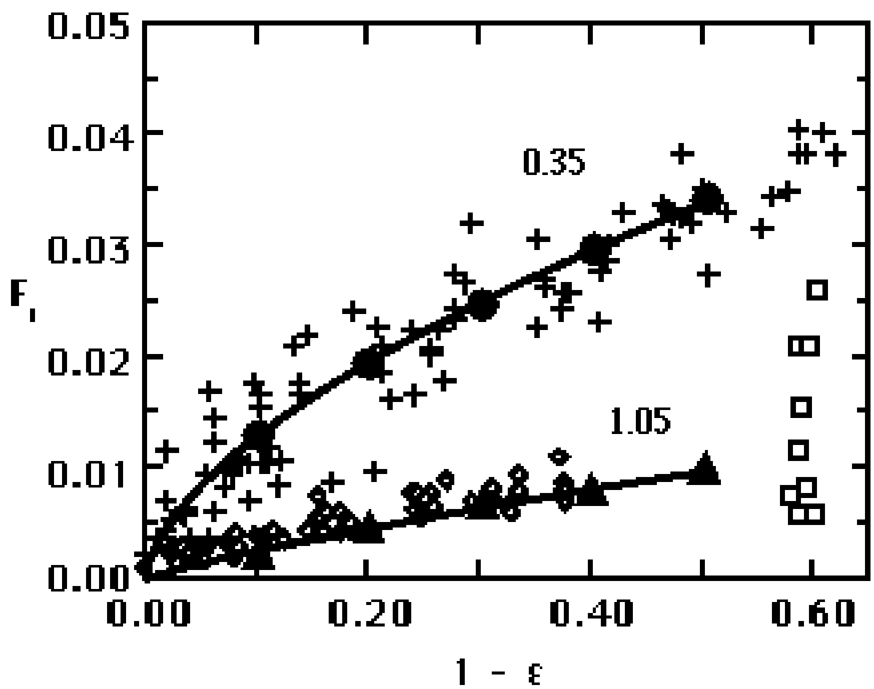
Lischer, D.J. and Louge, M.: “Optical fiber measurements of particle concentration in dense suspensions: calibration and simulation,” *Applied Optics* **31**, 5106-5113 (1992).

A fiber optic sensor that measures particle volume fraction in dense suspensions is calibrated against a quantitative capacitance probe. For homogeneous, dense, random suspensions of smooth, monodisperse, transparent dielectric spheres, the calibration is simulated using a ray-tracing Monte Carlo algorithm that predicts systematic uncertainties of the sensor's output, the extent of its measurement volume, and effects of changing its optical properties. The simulation shows that the output and accuracy of the sensor increase with decreasing sphere diameter and with increasing N.A. of the fiber. The output increases also when the ratio of the indices of refraction of the sphere and the suspending medium is increased. For small particles the measurement volume scales as the average interparticle distance.

Figure excerpts



Experimental results and predictions of the simulation for an optical fiber of 200µm core diameter and 0.37 N.A. in air. The experimental data are converted to F_r by assuming that the simulation predicts F_r correctly for 70µm particles at (1-ε)=50%. Plus signs and open diamonds represent particles with mean diameter of 70 µm and 210µm diameter, respectively. These data points are obtained by pouring particles randomly along the probe assembly. Open squares are data for closely packed 210µm particles with different random particle placements. The solid circles and triangles represent simulation results for 70 and 210µm particles, respectively. The lines are least-squares fits to these results of the form $F_r=k\ (1-\varepsilon)^m$.