Fourier-Bessel based Image Analysis for Multi-Parameter Particle Characterization

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Abstract
We demonstrate a novel particle characterization method based on decomposition of conventional microscopy images in Fourier-Bessel (FB) components. This allows the simultaneous measurement of size, refractive index, 3D position and orientation of single colloidal particles.

Method

Setup
A particle is illuminated with a white light source under a microscope. Scattered light is captured with a high magnification (100x) objective on a CCD camera.

Image analysis
The centroid is tracked and the centered image is decomposed in Fourier-Bessel image moments resulting in a set of $B_{n,m}$ values.

Conclusions
We conclude that the analysis using FB image decomposition can be used for simultaneous characterization of the size, refractive index and 3D position of single colloidal particles.

Results

Size extraction
Four different samples with monodisperse polystyrene particles ($d = 899, 940, 990$ and $1046$ nm) were characterized with the first 10 radial $B_{n,m}$ moments.

Refractive index extraction
The refractive index (RI) is extracted by projecting three $B_{n,m}$ coefficients ($B_{2,0}$, $B_{3,0}$ and $B_{4,0}$) on a well chosen plane with orthogonal basis $u$ and $v$.

Future prospects
In a next step we will demonstrate its applicability for tracking the orientation of non-spherical particles by including higher-order angular moments in the analysis. Additionally we will use this technique to measure local changes in RI of the medium.