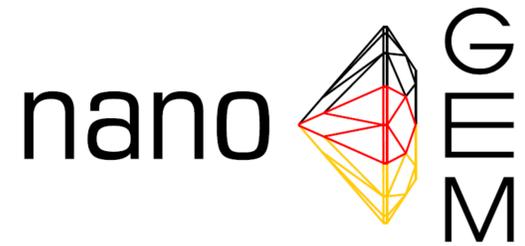
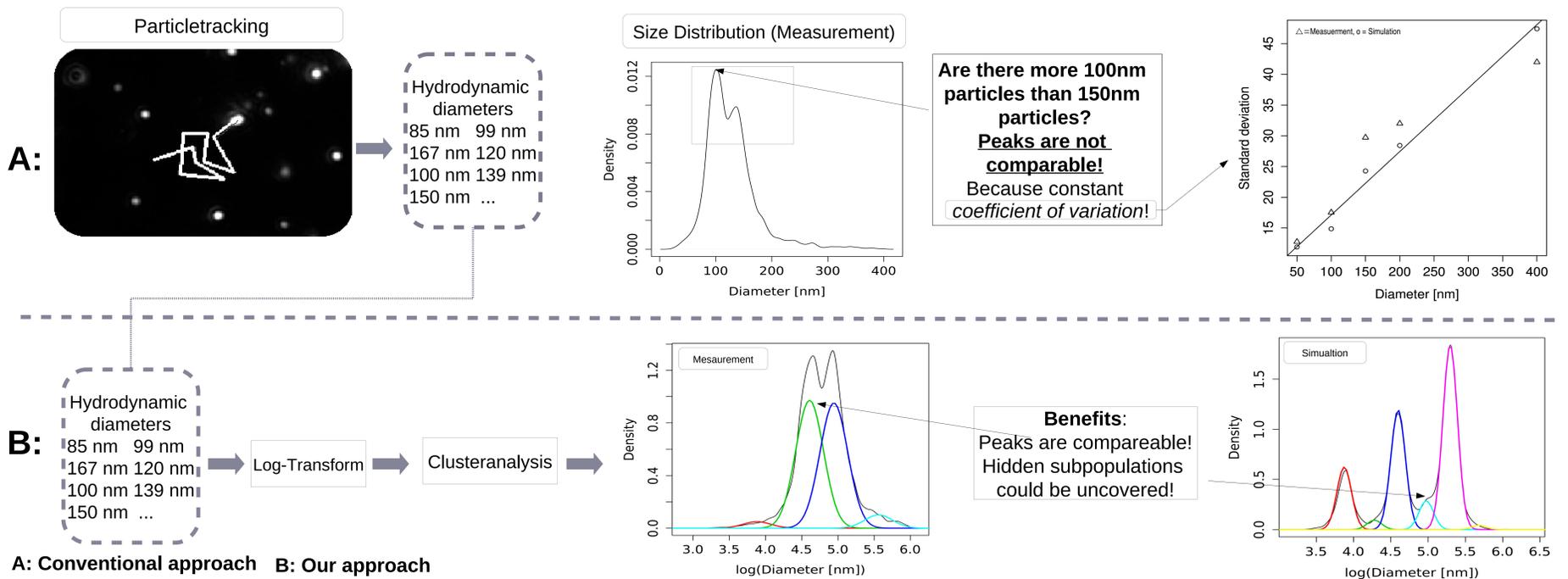


Nanoparticle Tracking: Improving Analysis for Size Distributions of Polydisperse Particle Suspensions



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Introduction

- The Nanoparticle Tracking Analysis allows to describe the particle size distribution (PSD) of nanoparticle suspensions.
- The variance (or the broadening) of the size distribution depends on number and duration of the observed particle tracks and, in particular, on the mean particle size.
- This broadening effect leads to hardly assessable modal values and difficult separation of populations of particles.
- We developed a method to reduce the broadening effect and improving the separation of populations.

Method of Nanoparticle Tracking Analysis

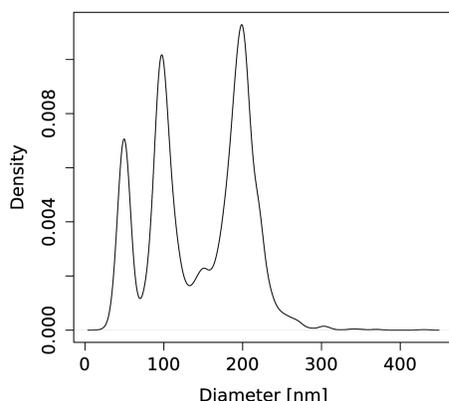
- Based on laser technology it is possible to visualize nanoparticles (NP) as light scattering objects by means of a light microscope.
- The snapshots of scattered intensity are in a permanent movement, since particles are subject to Brownian Motion
- Motion-Tracking was used to calculate the mean square displacement for each and every particle and the diffusion coefficient.
- By exploiting the Stokes-Einstein-Relation we can calculate the hydrodynamic NP-diameter.

Limitations of Conventional PSDs 1

- A Monte-Carlo simulation of a polydisperse suspension containing 50 nm, 100 nm, 150 nm and 200 nm particles was performed.

Diameter	50nm	100nm	150nm	200nm	Sum
Number	1.2 x 10 ⁴	2.2 x 10 ⁴	4 x 10 ³	4 x 10 ⁴	8 x 10 ⁴
Proportion	15%	30%	5%	50%	100%

Table: Composition of the simulated polydisperse suspension. The table lists the absolute and relative counts of steps taken per particle population.

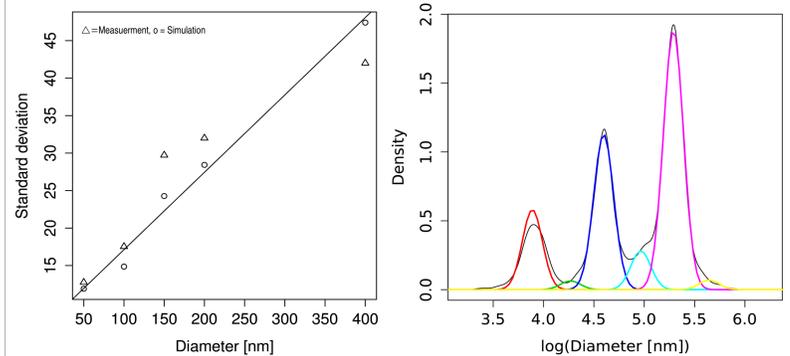


Limitation of Conventional PSDs 2

- **Limitation:** The modal values do not represent the real proportions of particle populations (e.g. 100nm & 200nm population).
- The reason for this misinterpretation is what we call the „broadening effect“, which is caused by the constant coefficient of variation of the PSDs.
- **Limitation:** It is possible that one population covers another population (e.g. 150nm & 200nm population).

Logarithmised Data and Cluster Analysis

- The logarithm stabilizes the variance of a statistical variable if it has a constant coefficient of variation (left figure)
- The diameter data were logarithmised to gain more comparability between the particle populations.
- A cluster analysis was done with the constraint „same variance“ using the logarithmised data (right figure & table)



Color	Red	Green	Blue (dark)	Blue	Yellow
Cluster mean	52	98	133	183	277
Proportion	14.9%	27.1%	9.3%	47.4%	1.1%

Table: Results of the cluster analysis of the virtual polydisperse suspension.

Conclusion

The procedure appears helpful to correctly interpreting the composition of polydisperse particle suspension.

Acknowledgment

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