DeepParticleNet & BigParticle.Cloud

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Introduction 1

Imaging Particle Size Analysis

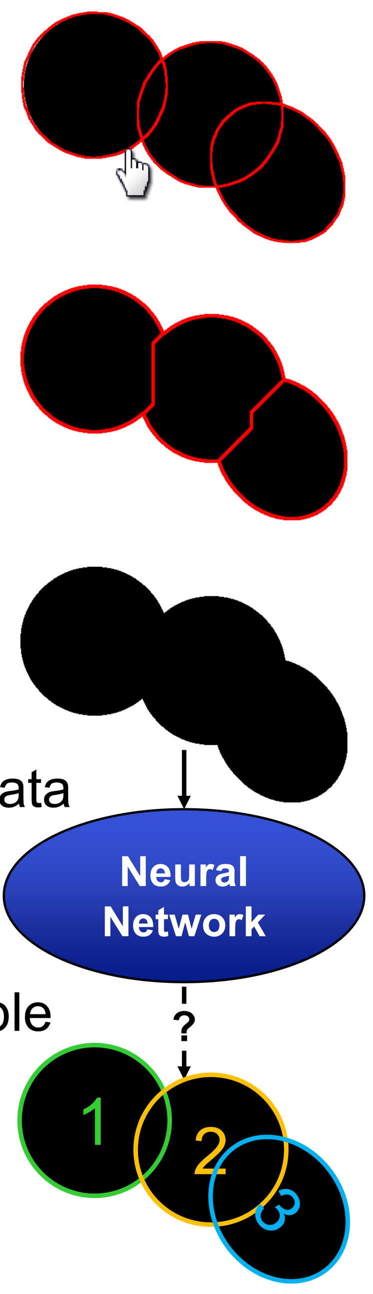
Manual method
+ highest accuracy available
– laborious and expensive

Established automated methods
+ quick and easy
– low accuracy for agglomerates

How about neural networks (NNs)?
+ self-learning structures
  → very flexible and adaptive
– need large amounts of training data
  → 100+ evaluated images

Problem:
- very little training data available

Solutions:
- Image Synthesis
- BigParticle.Cloud



Workflow 2

Image Distortion Analysis
- applied to real images
- basis for image synthesis

Image Synthesis
- as life-like as possible
  → realistic training conditions

Training
- synthetic images as input data
  → known particle areas/shapes
  → known particle positions
  → error of the NN's output can easily be quantified
- training ends when error is small enough
- slow process (hours to days)

Application
- real images as input data
- very fast process (< 1 second)

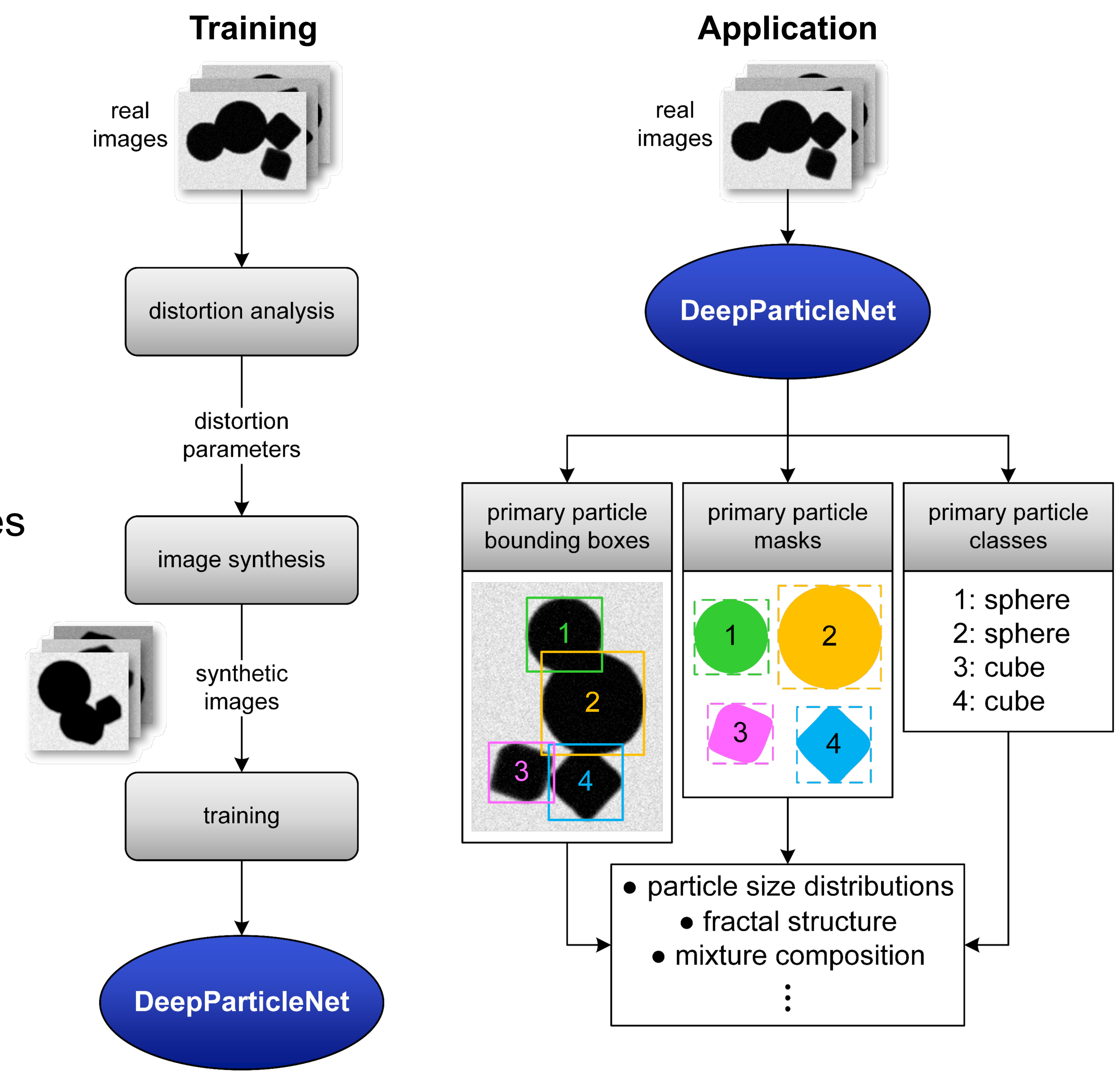
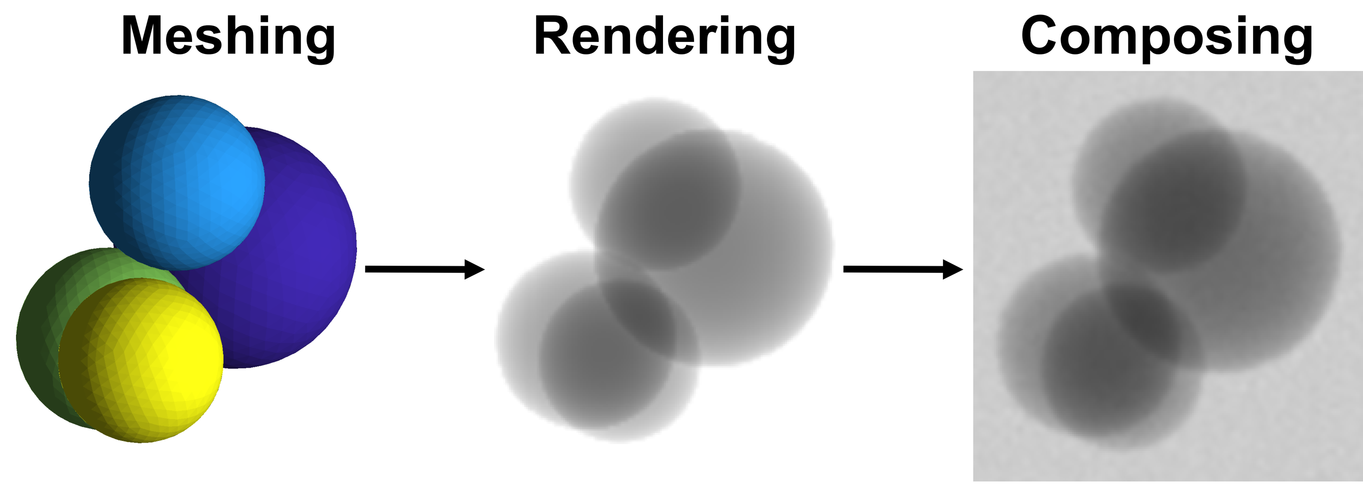
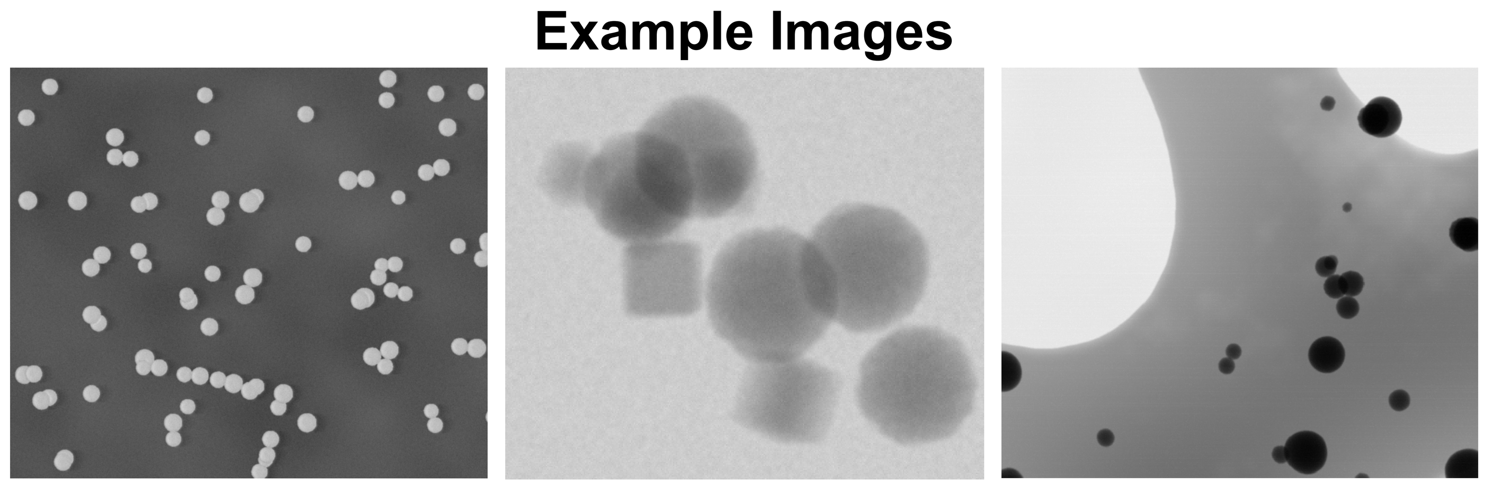


Image Synthesis 3

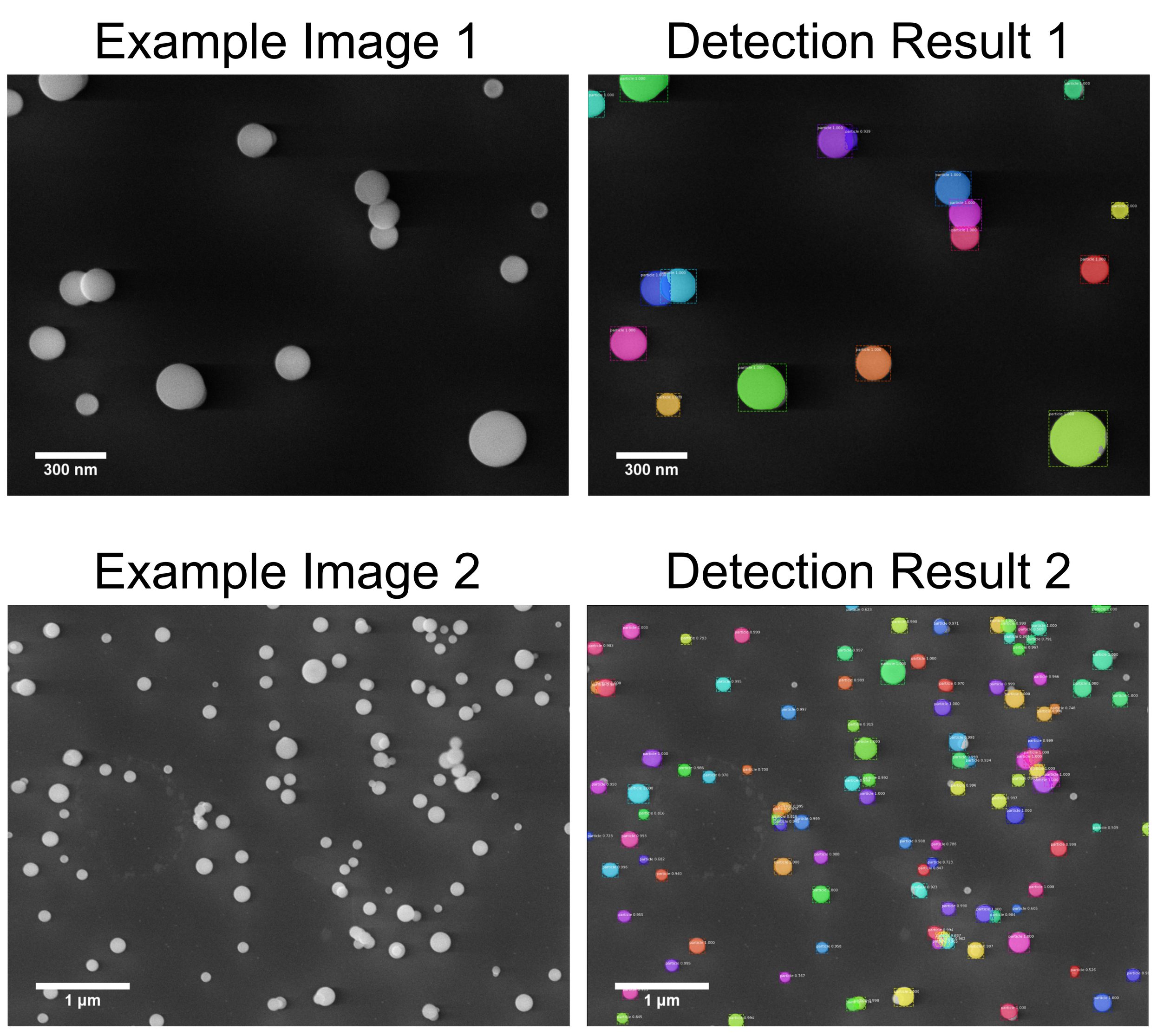
- arbitrary particle shapes
- various styles available
  - TEM/SEM
  - optical methods
  - many more possible
- easy to use toolbox





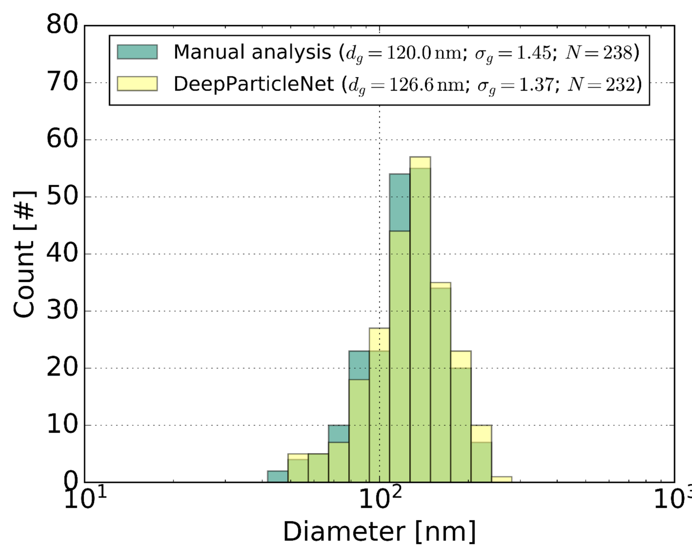
Results 4

Application to real SEM Images of SiO_2



Comparison

Manual analysis vs. DeepParticleNet



Detection errors:

$$\Delta d_g \approx 5.5\,\%$$
$$\Delta \sigma_g \approx -5.5\,\%$$
$$\Delta N \approx -2.5\,\%$$

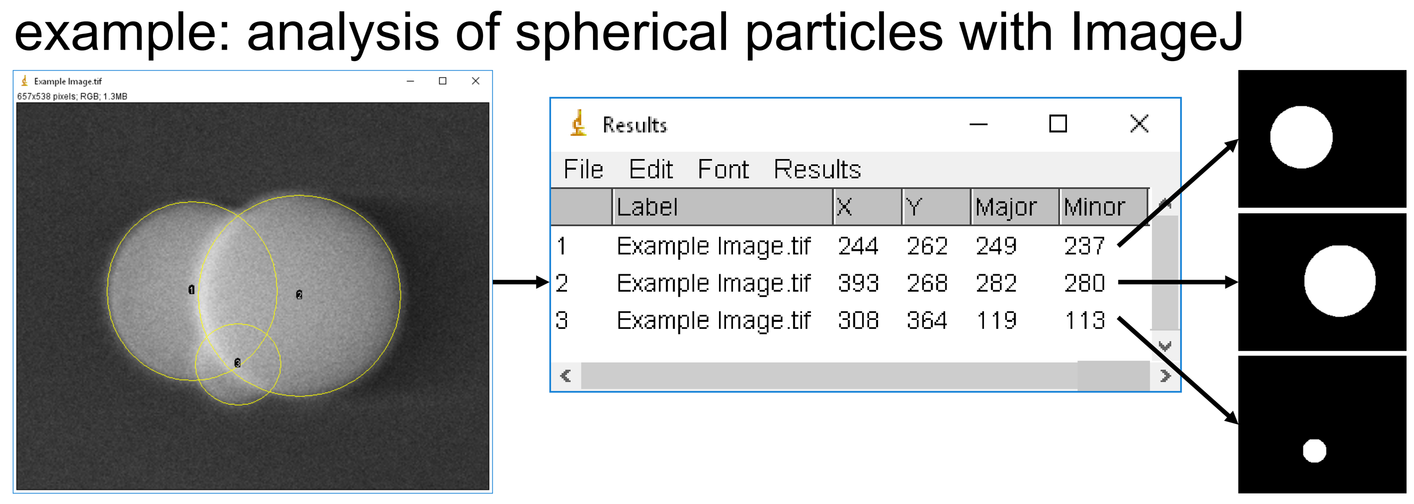
BigParticle.Cloud 5

Concept
- platform to gather and share training and benchmark datasets
- everyone can up- and download datasets

Motivation
- more data = better results
- we need benchmarks

www.bigparticle.cloud

Optimal Data Format: primary particle masks
- include <u>all</u> information about shape and position
- example: analysis of spherical particles with ImageJ



<u>Publication (preliminary work)</u>
Frei, Kruis (2018): Fully automated primary particle size analysis of agglomerates on transmission electron microscopy images via artificial neural networks . *Powder Technology (332), p. 120–130*

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