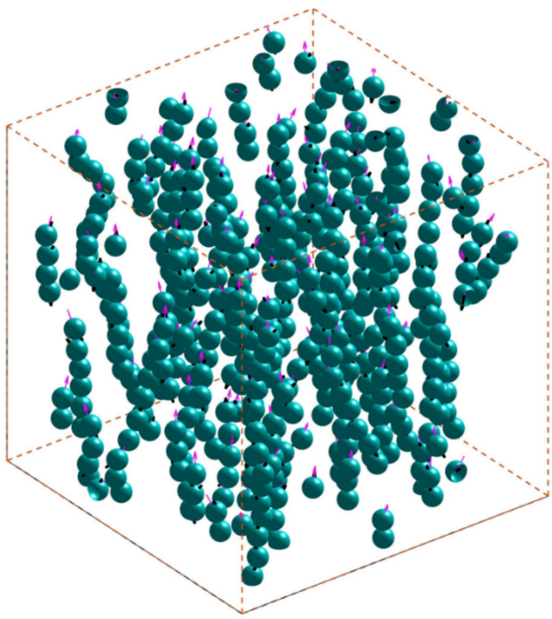
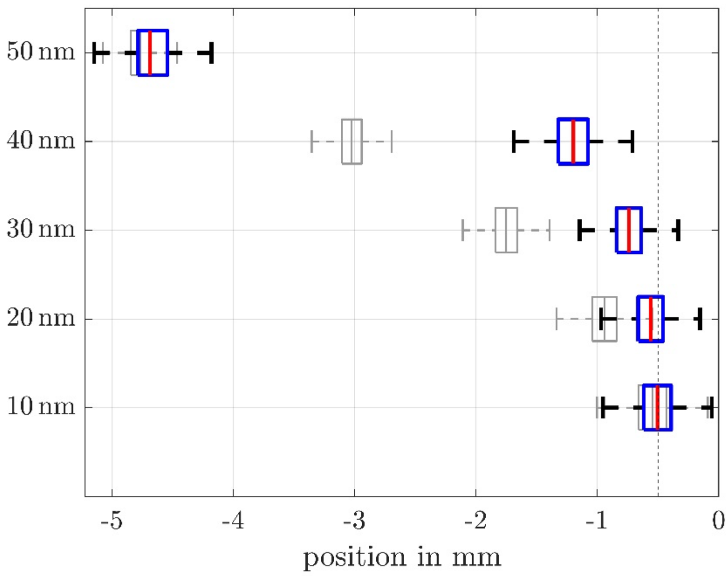
Master's Thesis: Experimental Validation of the Dual-Field Method for Size-Based Separation of Magnetic Nanoparticles

Magnetic nanoparticles play a central role in biomedical and technical applications such as hyperthermia, magnetic imaging and wastewater treatment. The effectiveness of these applications strongly depends on a narrow particle size distribution. In the size range of 20 to 200 nm in particular, conventional magnetic gradient separation techniques reach their limits. The interplay of thermal motion, magnetic forces and convection complicates precise separation.

A novel approach developed by our team to improve separation resolution involves the superposition of a homogeneous, alternating magnetic field with a temporally constant inhomogeneous field. This so-called dual field method uses size-dependent magnetization dynamics to selectively move larger particles, while keeping smaller ones nearly immobile. Simulations have shown that this approach significantly enhances separation efficiency compared to conventional methods.

The goal of this thesis is to experimentally implement the dual field method and investigate whether the effects observed in simulations can also be detected in a real-world setup. To this end, an experimental test rig will be designed, built, and operated.





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