

Modeling, simulation and optimal control of magneto two-phase flow for magnetic drug targeting

Dr. Jonas Knoch, FAU Erlangen-Nürnberg

Motivated by Magnetic Drug Targeting (MDT), we develop a thermodynamically consistent magneto two-phase flow model to describe the dynamics of superparamagnetic iron oxide nanoparticles (SPIONs) suspended in a carrier fluid under the influence of a magnet. The strongly coupled system consists of a modified Navier-Stokes equation with an additional inertia term for the volume-averaged velocity, a transport equation for the SPION volume density, and a quasi-static nonlinear elliptic equation for the magnetic potential. After closing the system using Onsager's variational principle, we provide and discuss a numerical framework and experiment-inspired simulations. On this basis, we develop an adjoint-based optimization algorithm that allows us to obtain optimal magnet control strategies for MDT experiments in branched blood vessels.