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Title: Coupled Simulation of Switching Arcs Considering Transient-Capacitive Effects

Abstract:

The simulation of physical phenomena in low-voltage switches is of special interest for academic research as well as for the industry, in particular, the simulation of the life cycle of electric arcs that are often generated during the switch-off process.
Short after the loss of electrical contact, the gas between both switch plates ionizes, and hence gets electrically conductive.High electric currents flow through the structure and can cause fatigue fretting or even damage to the device. Therefore, installations like extinguishing chambers or splitter plates are introduced to reduce these negative effects. The geometry of these parts can be improved using numerical simulations.
The dynamical behavior of the plasma column generated throughout this process is determined in part by two interdependent physical effects. The fluid is driven by the Lorentz force due to the magnetic field and the current distribution within the fluid. Additionally, it is heated by the ohmic losses generated by the electrical current in the conductive plasma. But equally, the electromagnetic field is dependent on the fluid motion.
Consequently, fluiddynamics, thermodynamics as well as electromagnetism need to be considered for numerical simulations. In this work a weak coupling between these regimes is applied on the simulation level. In contrast to existing approaches, the electro-quasistatic formulation is used for the electrodynamic simulation, i.e., solely the eddy-current term is neglected in the Maxwell equations. The idea is to include transient-capacitive effects in the simulation and to investigate the influence of these effects in low-voltage switches. This can be significant because of the fast changes in the material distribution related to the plasma movement. Two commonly used open source codes are coupled by means of a python coupling interface: GetDP for the electromagnetism and OpenFOAM for the fluid- and thermodynamics. First results of the coupled simulation will be shown in the presentation.

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