Electromagnetic Actuators Modeling, Simulation and Optimization: Review of Methods and Their Application for Switching Devices

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Abstract

Electromagnetic actuators are representing one important component of ABB's medium voltage reclosers [1, 2]. Their performance is strongly influenced by the considered material properties as well as by the electronic control units that will power the actuator.
Depending on the studied phenomena, different modeling, simulation and optimization methodologies are being used for medium voltage reclosers analysis. One could note: reduced order modeling approach [3], 2D static simulations [4], 3D transient analysis [4] or coupling of the Finite Element model with other mechanical simulation software. Once the models are being validated, they are integrated into an optimization loop in order to identify a robust design for medium voltage reclosers.

Therefore, this paper focuses on a review of the different methods employed for reclosers optimization and presents the advantages and the limitations of the different methods. In the first section, this paper gives an overview regarding the operating principle of a single phase recloser as well as the motivation of the research work. The second section presents the different modeling and simulation methods considered - from reduced modeling approach to 3D dynamic simulation. The models validation is presented in the third section. Different optimization case studies are also considered and presented in the next section whereas the final part of this paper presents the contribution of this work as well as the considered next steps.

Reference

[1] ABB Inc, GridShield 15/27/38 kV three-phase vacuum recloser, ABB Catalogue, 2012

[2] ABB AG Calor Emag Medium Voltage Products, Vacuum interrupters and Embedded Poles - Medium voltage, ABB Catalogue, 2012

[3] O. Craciun, V. Biagini, G. Mechler, C. Reuber: Multi-domain simulation and analysis of electromagnetically actuated reclosers, IECON2013, pp. 4222-4227, Wien, 2013.

[4] O. Craciun, V. Biagini, G. Mechler, G. Stengel, C. Reuber, A. van der Linden, Electromagnetic Actuators Modeling, Simulation and Optimization, Comsol Conference, Milan 2012.

Figures used in the abstract

Figure 1