Operation of an Electromagnetic Trigger with a Short-circuit Ring
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Introduction: Electromagnetic trigger is an essential constitutive part of circuit breakers, devices used to disconnect the load from electric appliance in case of an overload or short-circuit currents. A short-circuit ring in an electromagnetic trigger should reduce undesirable oscillations (vibrations) of a moving contact due to zero electromagnetic force between the anchor and the core at zero driving current.

Computational Methods: Time domain AC/DC module in the form of Ampere's law
\[ \sigma \frac{\sigma A}{\sigma t} + \nabla \times H = J_e \]
was used for numerical computation using Comsol Multphysics Vers. 4.2a.
A sinusoidal current was imposed to the windings. Ferromagnetic materials were described through built-in B(H) tabulated values for soft iron. In order to improve (enable) convergence, the MUMPS direct solver was used with Jacobian update on every iteration and Maximum number of iterations set to 25. Also, absolute tolerances of variables was tuned to enable convergence.

Results: Numerical simulations reveal importance of inclusion of proper B(H) material properties (compare figure 3a and 3b) in order to take into account material saturation effects. Induced current in the ring is zero at maximal applied signal (figure 3c) and maximal when applied current crosses zero (figure 3d).

Induced current in the ring results in no-zero force during applied signal crossing zero reducing the unwanted oscillations of the anchor and the striker pin.