Modeling and numerical simulation on launch dynamics of integrated launch package in electromagnetic railgun

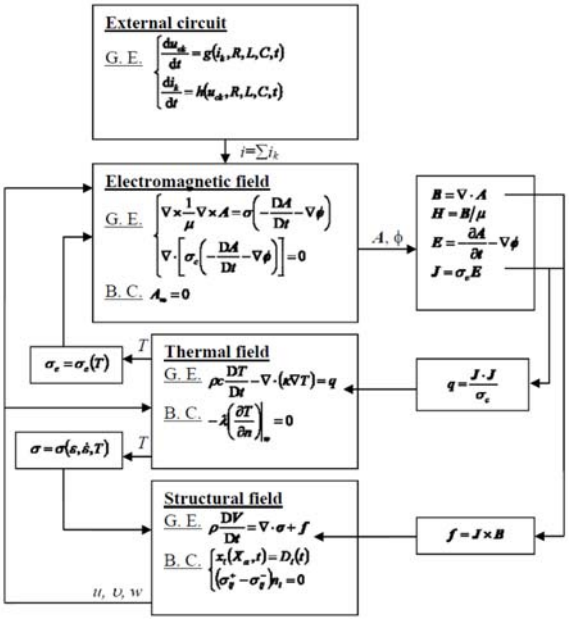
Qinghua Lin*, Baoming Li

National Key Laboratory of Transient Physics, Nanjing University of Science and Technology, Nanjing 210094, China

* E-mail: *tsh_lin@sina.com*

Models

The model consists of four parts: the external circuit, electromagnetic field, thermal field, and structure field. Given the geometric structures and material properties of the Launcher and ILP, as well as the external circuit parameters, the distribution and evolution of the electro-magnetic-thermal-mechanical quantities in the launching process can be calculated.

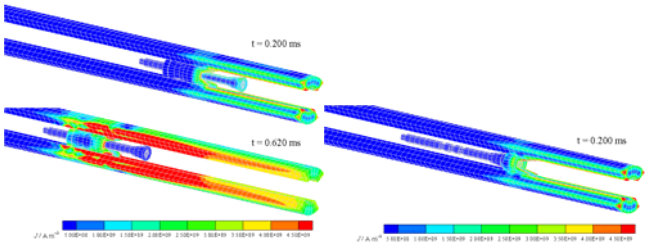


Numerical cases

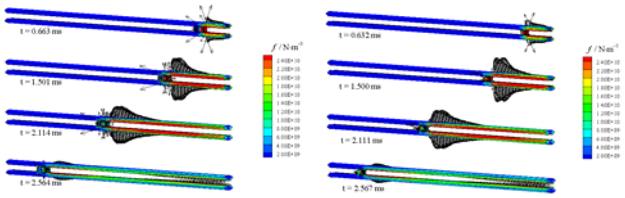
Numerical simulations were conducted for a railgun system composed of the capacitor-based pulse forming network, advanced containment launcher, and integrated launch package. The round-bore launcher has a caliber of 40 mm and a length of 2.4 m. It consists of five components, that is two rails, two insulators, and a filament wound housing. The configurations of two ILPs are the mid-riding and base-push respectively.

Results

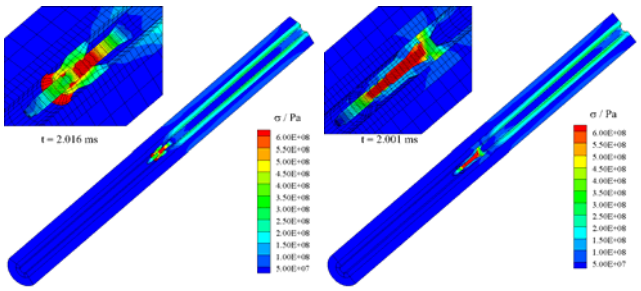
Some results about induced eddy currents, stress distributions, and projectile lateral motions show that the launch of ILP in a railgun is a complex dynamic process under multi-physical field coupling and multi-body interaction.



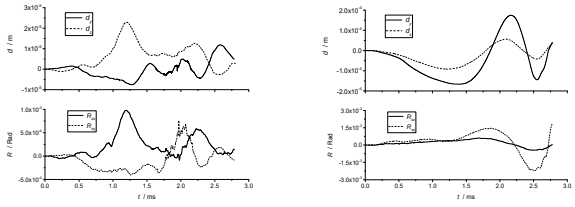
(a) Current density



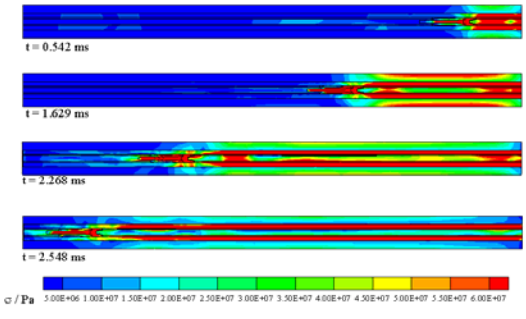
(b) Lorentz force



(c) Effective Stress



(d) In-bore lateral motion



(e) Stress evolution

Conclusions

The multi-physical field model can capture some details of the launch dynamics in railguns. It provides a method for evaluating the in-bore survivability of ILP and predicting the muzzle exit conditions.