Comparative Study of HTS linear synchronous motor with different core and winding structures for electromagnetic launching

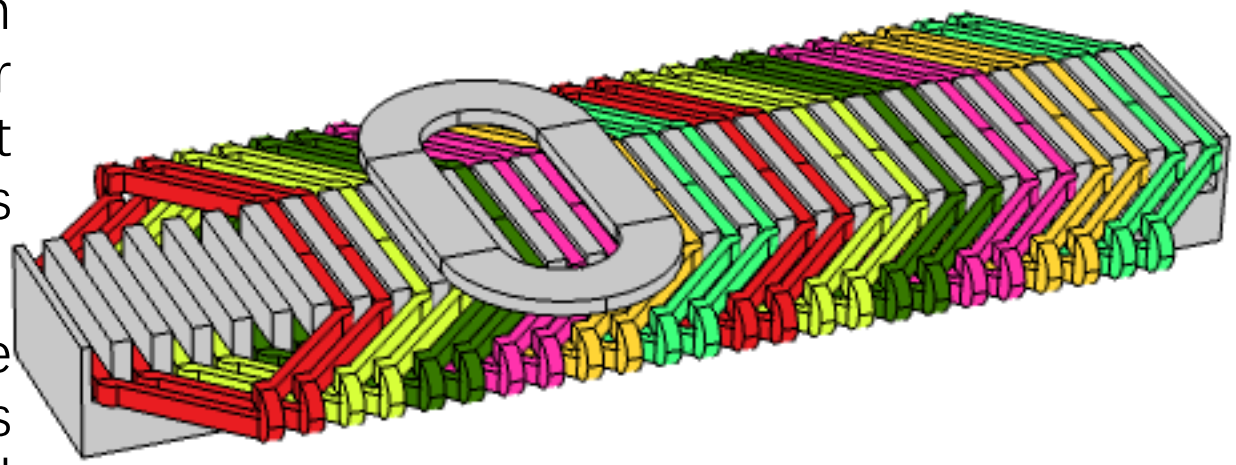
Naval University of Engineering

Ma Yuanzheng

Basic Structure of Linear HTS Motor for Electromagnetic Launching

In electromagnetic launch(EML) area, high temperature superconductivity(HTS) coil mover has the prospect to replace the permanent magnets in the LPMSM, and the motor's performance can be improved largely.

The picture shows a basic structure of the LSM. Its primary copper three phase windings provides a traveling field and the HTS coil fixed on the mover flowing a DC current keep a constant field, thus the mover can act with the speed of magnetic ffield.



The picture shows two kinds of winding configuration

Red=A phase

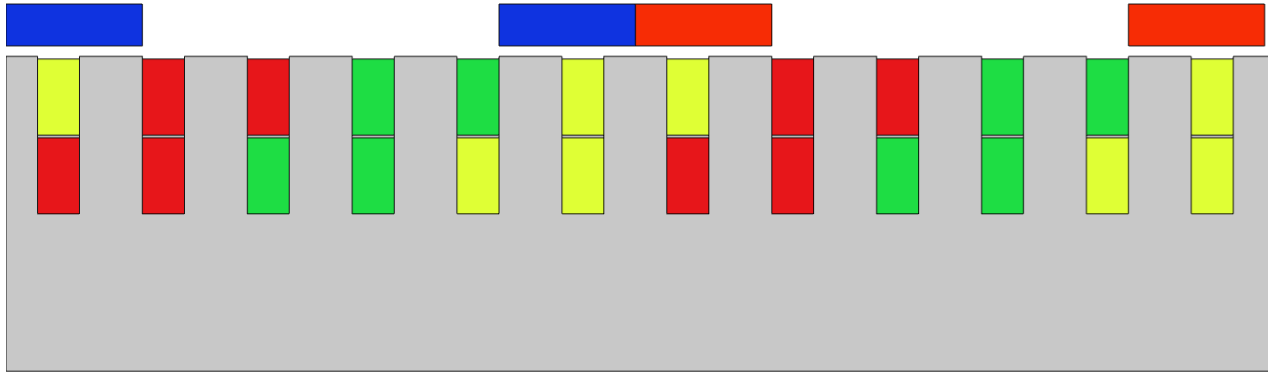
Yellow=B phase

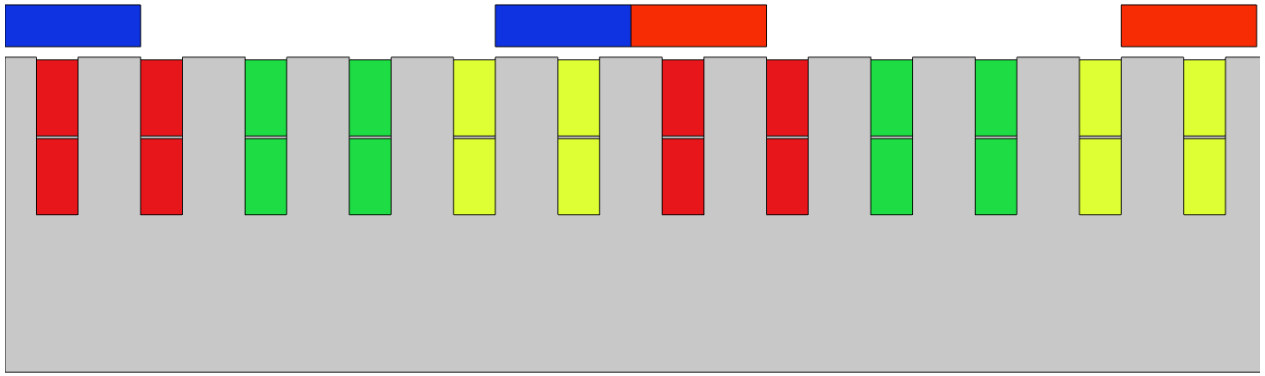
Green=C phase

Blue and Orange are mover coils

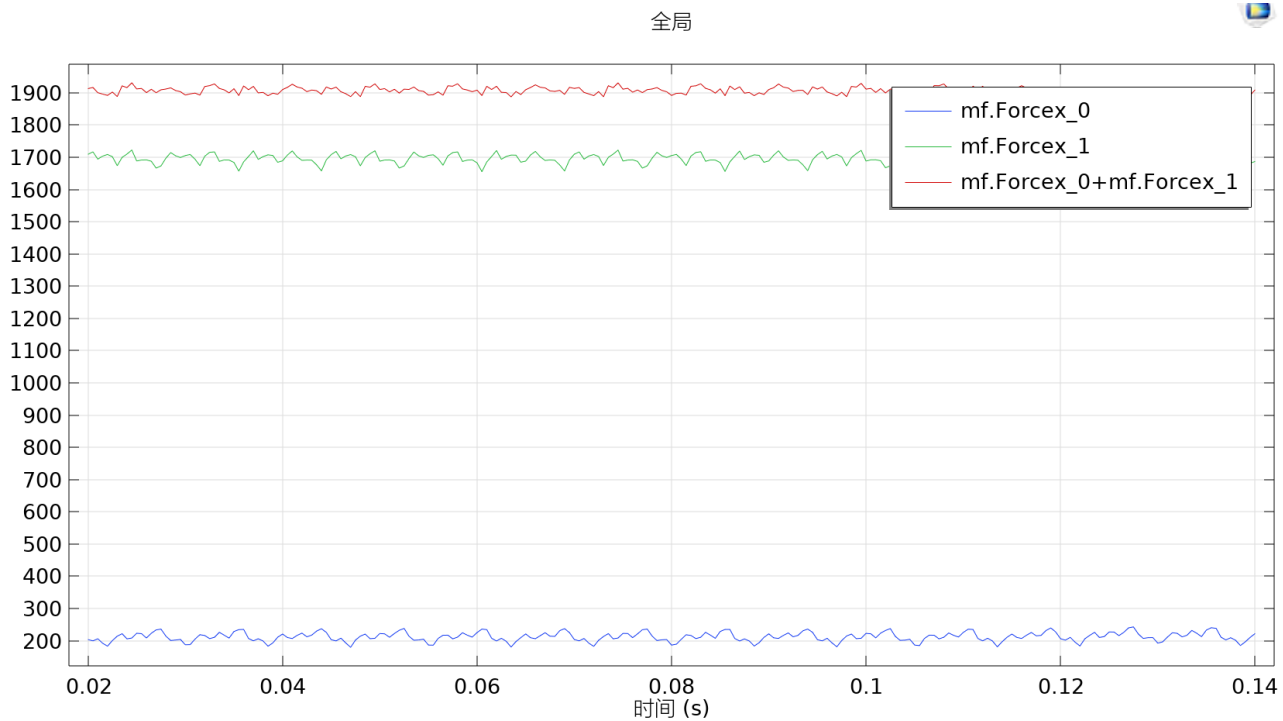
the difference of two motor is the coil in the slots, lower one has the same phase winding in every slot; for the upper motor, some slots have same windings while some slots has different windings.

Winding type A

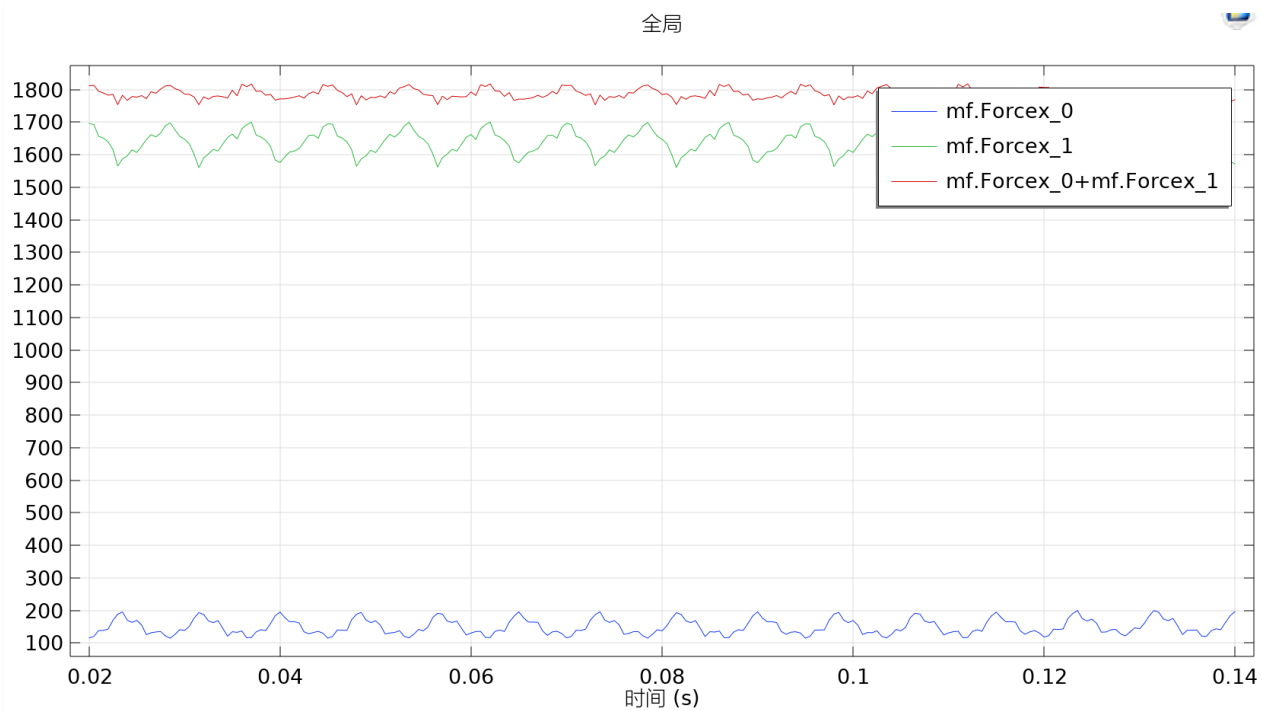




Winding type B

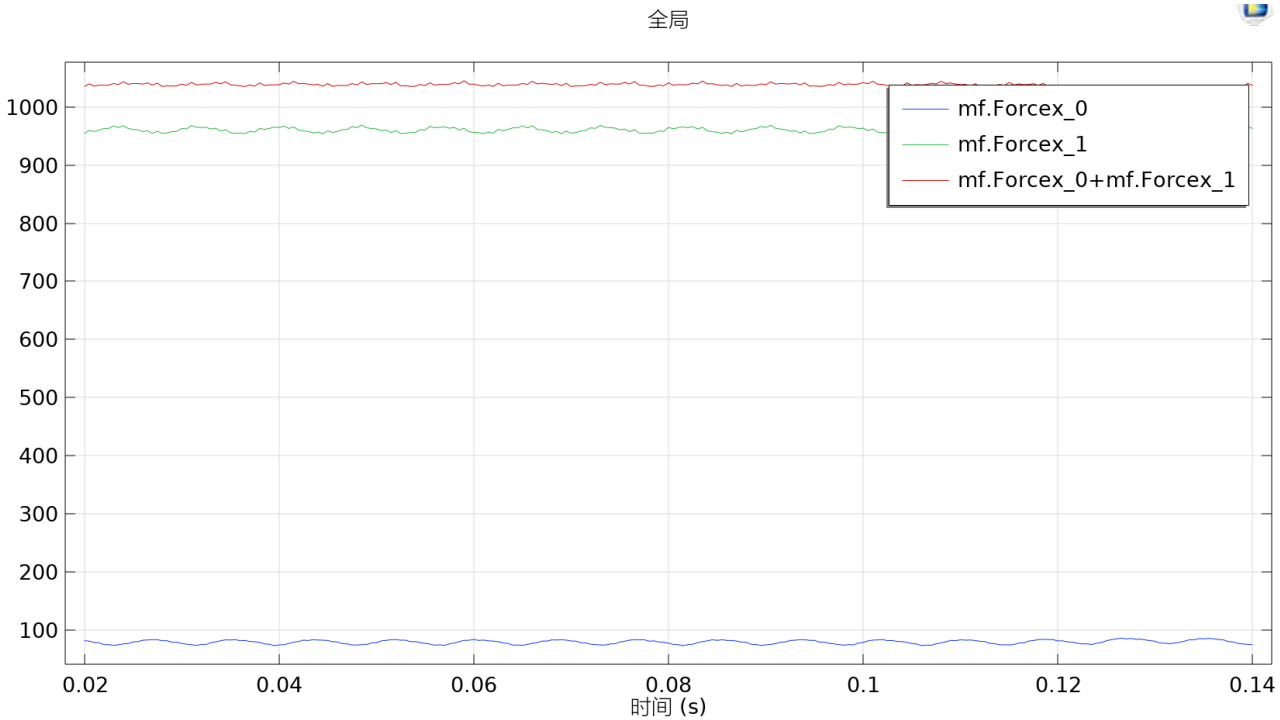


Winding type A

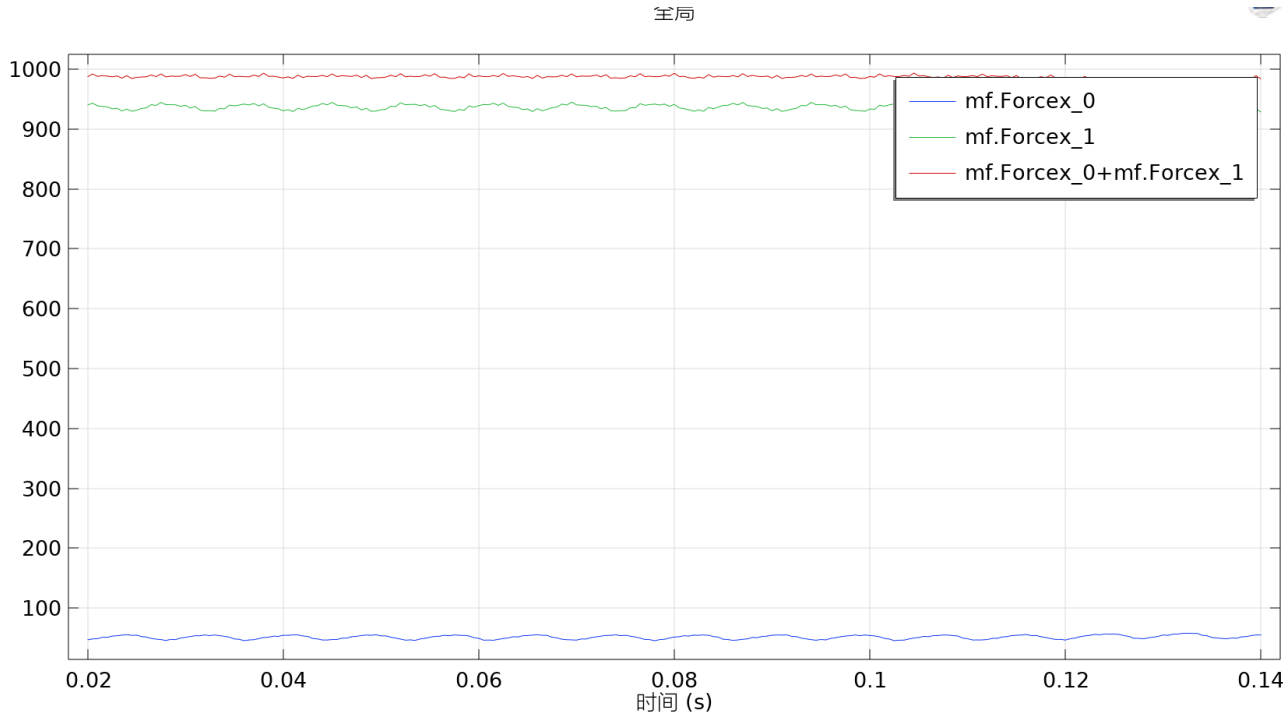


Winding type B

mf.Forcex_0 and mf.Forcex_1 are the blue HTS coil on the former PPT, and their sum force is also plotted. We can see that A has a high force and its wave is much smaller than that of B



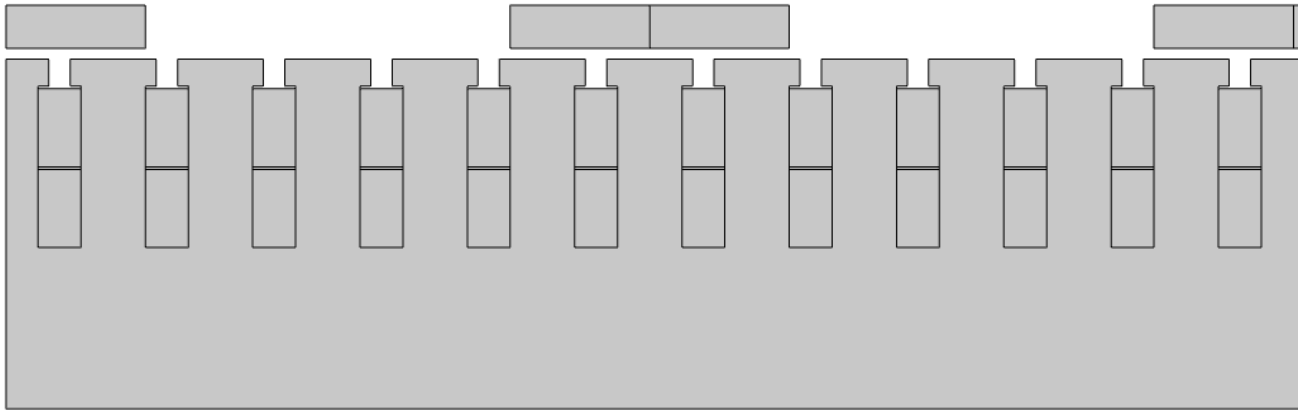
Winding type A

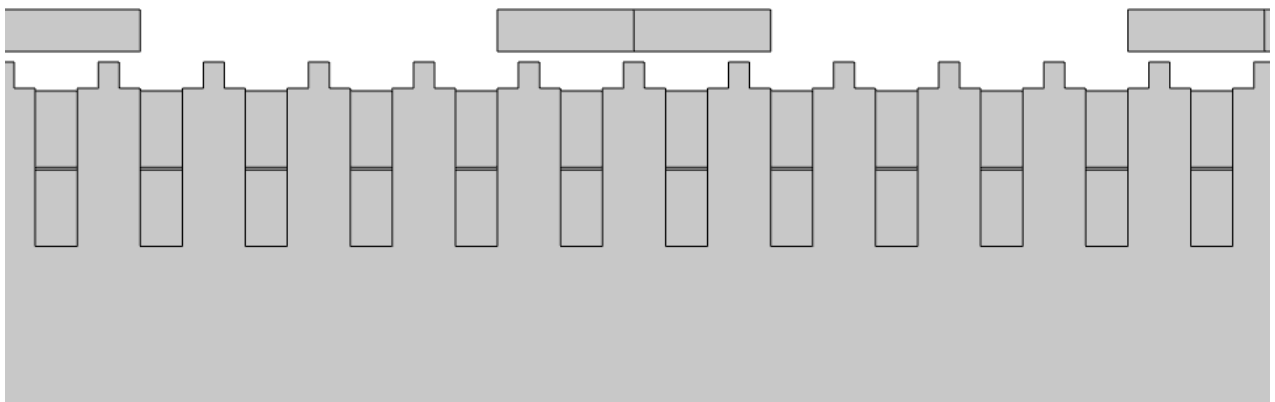


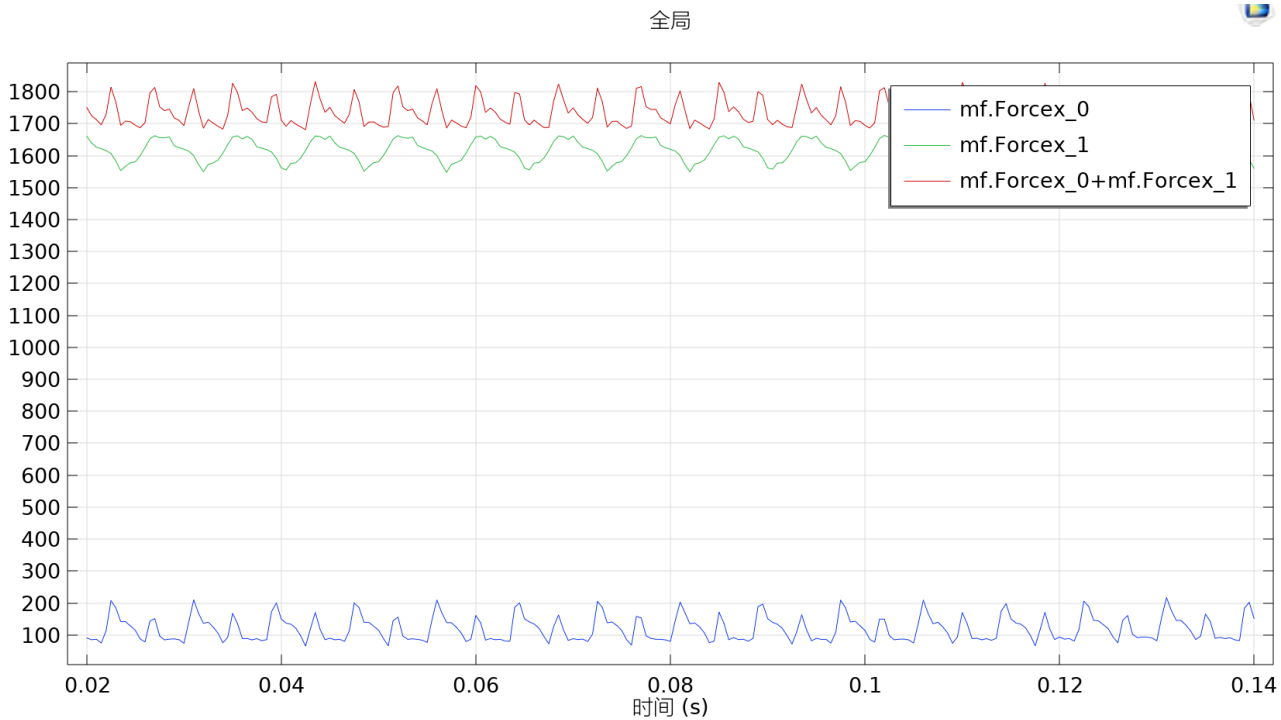
Winding type B

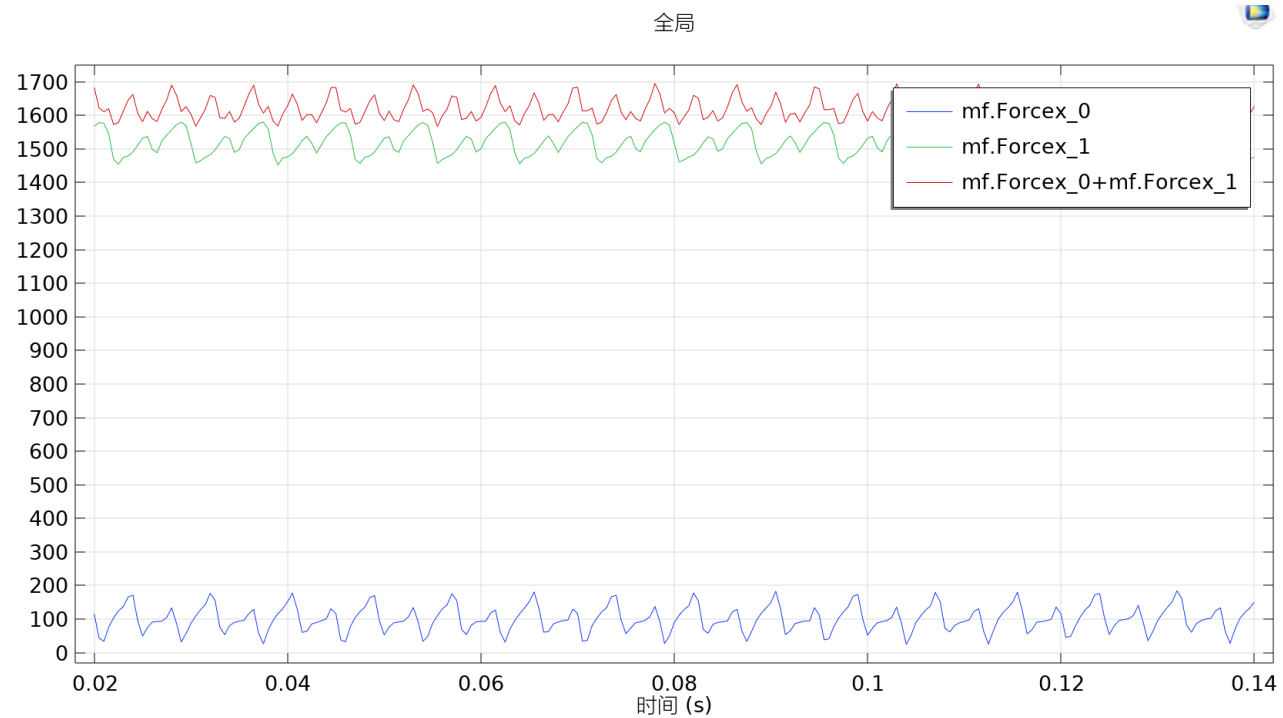
In this picture, the primary core is set as non-magnetic material. To simplify the simulation, we set the core as air, thus A and B are coreless LSMs, we notices that the A still has higher force than B. Besides, both have smaller force wave than the iron core LSM, so we may adopt the coreless motor plan to reduce the force wave in EML.

In this picture, winding type A motor's slot shape are designed seperatedlly. The airgap between the top of the primary core and the bottom of mover coil is set the same as before.









It seems both kinds of slot contributes less for the thrust force, and their force wave is higher than before. But for the lower motor in former PPT, its y-direction's force is smaller than upper motor, which means we can reduce the drag force of the mover to speed up the mover.