

Research on Radiated Interference of Motor Driven Converter of Electric Vehicle

Guangyu Zhang, Fanyun Kong, Junyan Wang, Qiuming Ai, Ranran Gu

Harbin Engineering University Harbin, China

Introduction

Aiming at the difficulty of predicting electromagnetic radiation interference in electric vehicles and the long simulation time, this paper proposes a field-circuit coupling simulation method. The software simulation of the road is used to extract the radiation interference source of the drive converter, and the cavity of the electric vehicle is established. The simulation model of the body uses the FDTD method to solve the spatial electromagnetic field distribution.

Methods

The simulation of the permanent magnet synchronous motor drive system can be completed with Simulink Toolbox in the engineering software MATLAB.

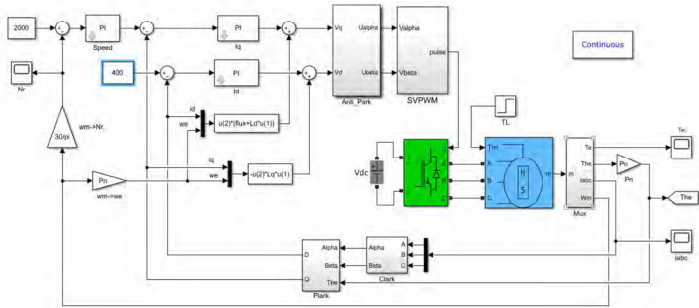


Fig. 1. Simulation model of vector control system of permanent magnet synchronous motor

The peak-to-peak value of this three-phase motor is about 100A. The load has spectrum sensitive devices and no filter is used, the harmonic components of the current waveform are relatively large.

According to the actual situation of electric vehicle cables, the cables are approximated. Use FEKO's own Cables toolbox to perform simple modeling of the power bus.

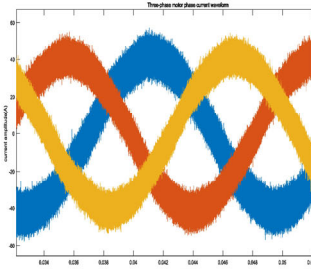


Fig. 2. Phase current waveform



Fig. 3. Schematic diagram of equivalent circuit when bus cable works

Results

This article sets the excitation source as an impulse signal to obtain the response in the entire spectrum. The electric field time domain response curve is almost a mixture of natural function and high frequency noise, and the magnetic field is also relatively similar.

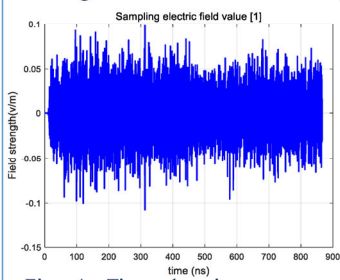


Fig. 4. Time domain response of electric field intensity generated by a constant current source in MATALB at 3 meters

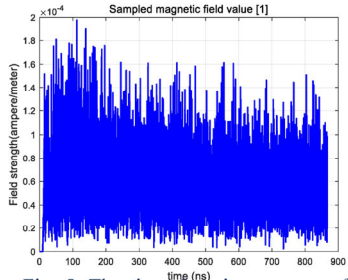


Fig. 5. The time domain response of the magnetic field intensity generated by the constant current source in the MATALB at 3 meters

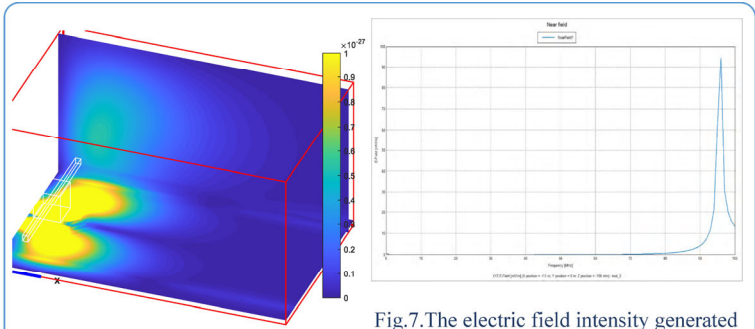


Fig.7.The electric field intensity generated by the constant current source in FEKO at 3m (mV/m)

Fig. 6. FDTD body surface current map 3m (mV/m)

The simulation results of the magnetic field show that the magnetic field is mainly concentrated in the low frequency band. It can be seen from the figure that the surface current of the car body Mainly concentrated on the position of the car chassis near the motor and the side of the car.

The current distribution on the surface of the car body in FEKO is more consistent with the FDTD algorithm. , So it can basically be determined that the FDTD algorithm has a certain practical significance in the research background of this article.

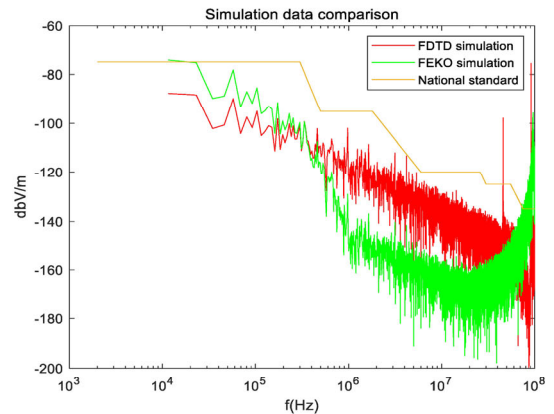


Fig. 8. Comparison of electric field simulation values Conclusion

Multiply the frequency domain results obtained in FEKO and MATLAB with the corresponding frequency points of the frequency domain data of the permanent magnet motor's bus current, and visualize the obtained results to obtain Figure 8.

Conclusion

- As far as the overall data analysis is concerned, the interference is mainly concentrated below 100KHz.And all the simulation data meet the national standard limit value.
- The simulation value of the FDTD algorithm is more in line with the real situation under certain circumstances.
- There is a certain difference between the simulation data of FEKO and the FDTD method. But the overall frequency attenuation trend is consistent with FDTD. Because the radiated interference value is small at frequencies above 300KHz, and it does not exceed the limit specified by the standard.
- Each software can successfully simulate the radiation interference of the motor and give different reference values. All of them comply with the national standard limit.

ACKNOWLEDGEMENTS

This paper was supported by 'Key Laboratory of Advanced Ship Communication and Information Technology' of Ministry of Industry and Information Technology Harbin Engineering University.