

A Preliminary Study of Magnetic Fields on Railway Vehicles

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1. Background

In Japan, regulations on low-frequency magnetic fields began taking effect now in force. Initial regulations in 2011 applied to electric facilities in general, but the scope of regulatory control was expanded in 2012 to cover railway electric facilities on the ground. Although railway vehicles are not included in the scope of regulation at the moment in Japan, we think that it is necessary to assess the magnetic fields in the space on railway vehicles (hereinafter referred to as “car-borne magnetic fields”). Thus, we are now beginning to evaluate car-borne magnetic fields.

2. Analysis of magnetic fields

As a number of magnetic field generating sources exist on and around railway vehicles, it is thought that the vehicles are subjected to a wide variety of magnetic fields. RTRI is studying a theoretical technique to analyze car-borne magnetic fields. To calculate the magnetic fields on railway vehicles where magnetic materials and conductors exist in quantities, we cannot rely on simple calculation formulae, but are required to perform analysis of magnetic fields. Therefore, we created a model that considers the effects of magnetic shields and car body structures and so on, to analyze the car-borne magnetic fields. We are now using the model to calculate car-borne magnetic fields by the finite element method or other means (Fig. 1). We believe that it is possible to use this technique to check in advance the effects of shields on railway vehicles.

3. Dosimetry

The ICNIRP (International Commission on Non-Ionizing Radiation Protection) guideline on the environmental magnetic fields prescribes that, in cases where a magnetic field exceeds the “reference levels” (Fig. 2) it shall be evaluated in terms of the electric field strength induced in the human body in low-frequency magnetic fields (This is called “the

basic restrictions”).

To calculate the electric field strength induced in the human body, we developed a technique to input the distribution of the car-borne magnetic fields into a numerical model of the human body which had been developed by



National Institute of Information and Communication Technology (Fig. 3). By this technique, we are able to evaluate the effect of car-borne magnetic fields on the human body without directly measuring the induced electric fields.

4. Conclusion

RTRI thinks that magnetic fields in the environment are a matter of primary concern in Europe. It was decided that new regulation would be introduced last summer by an EU directive on the direct current magnetic fields in the environment surrounding professionals. We will continue research in this field from now on while keeping an eye on the development of the issue around the world.

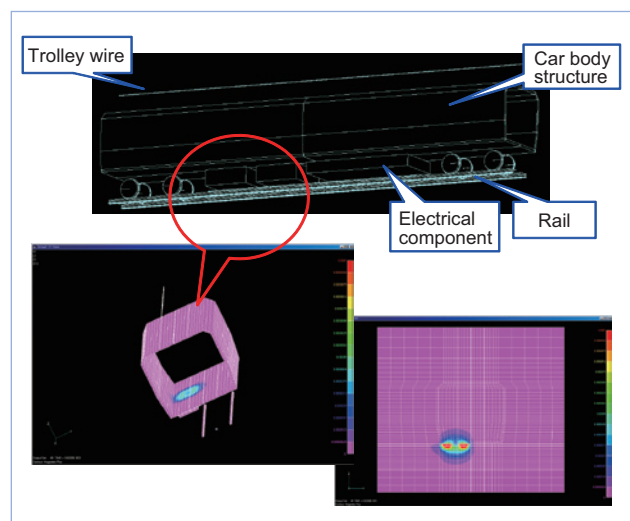


Fig. 1 Analysis of magnetic fields on railway vehicles

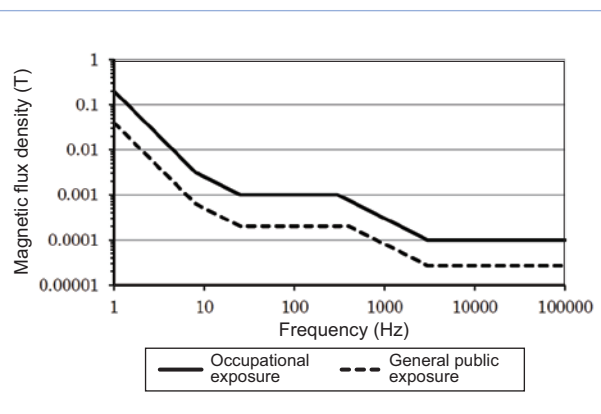


Fig. 2 Reference levels, ICNIRP guideline

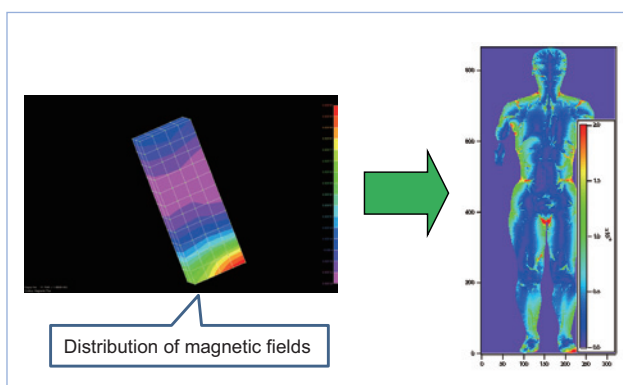


Fig. 3 A calculation of the electric field strength induced in the human body using a numerical model