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Modelling of the Return Traction Current Harmonics Distribution in Rails for AC Electric Railway System

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Abstract:

The problem of determination of the traction current harmonics distribution in rails generated by several trains that operated in AC feeder zone is considered. The investigations were caused by necessity to ensure electromagnetic compatibility of the new types of rolling stock equipped with electronic static converters with track circuits that are used in train movement control systems for detection of their positions. The great diversity of rolling stock, power supply and return current systems, and train detection systems installed in European countries leads to consideration of the electromagnetic compatibility problem taking into account the specific railway systems used in the each country. Investigation of the electromagnetic compatibility between different railway subsystems requires the use of simulation programs that help to reveal most critical conditions for electromagnetic compatibility at an early stage and also makes it possible to estimate electromagnetic interference from rolling stock in rails under the worst-case conditions, realization of which in the operating systems will require a lot of time and cost. This work consider evolved model for distribution of the traction current harmonics in rails from several trains. To illustrate the application of the considered model, the distribution of the traction current harmonics in rails was computed for 25 kV AC direct feeding network depending on distance from electrical supply substation, the rail-to-earth conductance, and the number of trains in the feeder zone. The results of modeling of the harmonics distribution are in satisfactory agreement with the experimental data.

Keywords: traction current harmonics, track circuits, electromagnetic compatibility, mathematical model

I. Introduction

The electrified railway is one of the most powerful wide-frequency sources of electromagnetic influence on signaling and telecommunication systems. Electromagnetic compatibility (EMC) between different railway systems is very important for the realization of the high speed railway lines and their integration with existing old railway systems.

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