***Abstract*—Simulation models must have a level of detail consistent with the prescribed goals and considered time span. Electrified railway lines require simulating trains during their typical trips, with acceleration and braking transients lasting at least several seconds or some minutes;. On the other hand, AC lines have quantities (voltages, currents) which vary much faster, e.g. at 50 or 60 Hz.**

This paper discusses how to model railway electric supply networks with a complexity adequate for long-run simulations, while still having good precision and details on the results. In particular, it discusses the usage of hybrid models combining the use of complex impedances for the supply system with dynamic models of trains. It also discusses the use of supply line models having a reduced number of conductors to make them smaller and faster to simulate, without loss of precision.

The proposed techniques are implemented in models written in the Modelica simulation language, and results are shown, which compare precision and computational efficiency of models using the proposed technique with others built in a more conventional time-domain way.