Abstracts

FD--TLM Electromagnetic Field Simulation of High-Speed Josephson Junction Digital Logic Gates

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The finite-difference transmission line matrix (FD-TLM) method is extended to modeling low-T/sub c/ Josephson junction (JJ) digitial logic integrated circuits (IC's), providing comprehensive simultaneous time-domain, three-dimensional (3-D) full-wave electromagnetic field and JJ device analysis. Techniques for FD-TLM modeling of a Josephson Atto-Webber switch (JAWS), a two-junction superconducting quantum interference device (SQUID), and modified variable threshold logic (MVTL) logic gates are discussed and simulation results are presented. Interconnection lengths are intentionally short so that the full-wave FD-TLM simulation results can be validated with results of conventional quasistatic-based circuit simulations. Good agreement between the simulation techniques validates the FD-TLM JJ logic circuit modeling approach. In the FD-TLM method the electromagnetic behavior of the circuit is modeled from the material properties and dimensions of the circuit, avoiding separate extractions of parasitic capacitance and inductance as needed in conventional circuit simulations.

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