Nanoscale Electromagnetic Elements: Computational Aspects

by

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Abstract

The use of the Finite Difference Time Domain (FDTD) and the Transmission Line Matrix (TLM) algorithm to model nanoscale electromagnetic elements is investigated. It is found that comparable accuracy of the TLM algorithm to the FDTD algorithm combined with significant practical reductions in computation time render TLM a superior algorithm for nanoscale optoelectronic problems. It is also found that as the as the TLM algorithm implicitly incorporates "split fields" into its definition that it lends itself to a natural and simple implementation of the Berenger Perfectly Matched Layer from FDTD that appears not to have been reported in the literature. In the course of the research an extension to the Drude Lorentz complex permittivity model of gold is developed that provides coverage across the entire optical spectrum. This extended model is then used to validate the TLM algorithm against known the known optical response of a variety of objects including gold films, nano spheres and nano rods. The effect of coupling between elements of an array of nano scale objects is investigated with a consistent blue shift in the extinction spectra for arrays of closely spaced nanoscale objects observed.

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