Abstracts

Divergent fields, charge, and capacitance in FDTD simulations

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Finite-difference time-domain (FDTD) grids are often described as being divergence-free in a source-free region of space. However, in the presence of a source, the continuity equation states that charges may be deposited in the grid, while Gauss's law dictates that the fields must diverge from any deposited charge. The FDTD method will accurately predict the (diverging) fields associated with charges deposited by a source embedded in the grid. However, the behavior of the charge differs from that of charge in the physical world, unless the FDTD implementation is explicitly modified to include charge dynamics. Indeed, the way in which charge behaves in an FDTD grid naturally leads to the definition of grid capacitance. This grid capacitance, though small, is an intrinsic property of the grid and is independent of the way in which energy is introduced. To account for this grid capacitance, one should use a slightly modified form of the lumped-element capacitor model currently used.

❑ Return to main document.