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Fractional models in solving Maxwell equations and applications

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In numerical modeling, it is common to solve coupled differential equations in one-, two- or three- dimensions (1D, 2D, or 3D) with corresponding boundary conditions. For some complicated objects, the dimension may be strictly 1D, 2D or 3D, where the normal computational approach may be expensive. By using fractional models that had been developed mathematicians, the complicated object is projected into a "fractional" dimension in order to solve the relevant equations in this non-integer dimension with the assumption that the effects at smaller scales can be ignored. In this talk, we will present some recent results of using such "fractional"models on Maxwell-equation based problems such as fractional Child-Langmuir law for high current cathode, Fractional Mott-Gurney law for space charge limited current transport in organic diode, Fractional Fowler Nordheim law for field emission from rough surface, Fractional Fresnel coefficients for laser absorption/reflection on a rough metal surface and Fractional capacitance of a planar capacitor. These new fractional models will provide useful fractional parameters that can be characterized by experimental measurement. Smooth transition between the fractional models and the traditional models is demonstrated. The calculated results will be compared with available experimental results or numerical results obtained from commercial solvers and the comparison shows good agreement.

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