Solutions of Wave Equation in Fractional Dimensional Space

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Abstract:

A wave equation is solved in a fractional space of dimension D, $0 < D \leq 3$. We define a Fourier transform method and its inverse transform as a new technique to solve a non-homogenous partial differential equation in a fractional dimensional space. The method is applied to an electromagnetic wave equation for an arbitrary source distribution (charge or current densities) in the form $f(\mathbf{r}', t')$, where $\mathbf{r}'$ represents the space coordinates of a point on the distributed source and t' is the time at which the source at the point is turned on. The solutions for the potentials are obtained in terms of a fractional Green's function (Kernel) $G_D(\mathbf{r}, \mathbf{r}', t, t')$ which depends on the dimension D of the space. Here $\mathbf{r}$ is the location of the observation (detection) point, and t is the time at which the signal is detected at the point. A compact form for the Green's function is also obtained. It is shown that the time required for the wave to propagate from the source point to

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[2] N. Laskin, arXiv: quant-phy/0206098.