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# A K-Domain Method for Fast Propagation of Electromagnetic Fields Through Graded-Index Media

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## Abstract

In this work we offer a k-domain-based method for the fast calculation of fields propagating through graded-index (GRIN) media. It is potentially fast because of two reasons: (1) in the k-domain, Maxwells equations for GRIN media become ordinary differential equations, so that we can take advantage of Runge-Kutta-type mathematical approaches to reduce the numerical effort; (2) taking advantage of fast Fourier transform algorithms to convert the convolution-type calculation ( $O(N^2)$ ) into a multiplication ( $O(N)$ ). Several advantages arise when comparing this work with the famous split-step method: there is no paraxial approximation and the GRIN dependence along the main propagating direction can be accurately modeled.