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## Bidirectional Beam Propagation Method for Second-Harmonic Generation in Engineered Multilayer Photonic Bandgap Structures

### **Abstract**

The transfer matrix method (TMM) has been used to analyze plane wave and beam propagation through linear photonic bandgap structures. Here, we apply TMM to determine the exact spatial behavior of TE and TM waves in periodic refractive index nonlinear structures of arbitrary thickness. First, we extend the TMM approach to analyze plane wave propagation through Kerr type nonlinear media. Secondly, In the second order nonlinearity case, the proposed TMM takes into consideration reflections and the interferences between the forward and backward-propagating waves but the nonlinear process is assumed to be weak so that the pump wave is unaffected by the nonlinear process thus the undepleted approximation. Finally in the second order nonlinearity case, the TMM is applied to study beam propagation in such media by applying the TMM to its angular spectrum components.