# Wavelet-based analysis of transient electromagnetic wave propagation in photonic crystals

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Photonic crystals and optical bandgap structures, which facilitate high-precision control of electromagnetic-field propagation, are gaining ever-increasing attention in both scientific and commercial applications. One common photonic device is the distributed Bragg reflector (DBR), which exhibits high reflectivity at certain frequencies. Analysis of the transient interaction of an electromagnetic pulse with such a device can be formulated in terms of the time-domain volume integral equation and, in turn, solved numerically with the method of moments. Owing to the frequency-dependent reflectivity of such devices, the extent of field penetration into deep layers of the device will be different depending on the frequency content of the impinging pulse. We show how this phenomenon can be exploited to reduce the number of basis functions needed for the solution. To this end, we use spatiotemporal wavelet basis functions, which possess the multiresolution property in both spatial and temporal domains. To select the dominant functions in the solution, we use an iterative impedance matrix compression (IMC) procedure, which gradually constructs and solves a compressed version of the matrix equation until the desired degree of accuracy has been achieved. Results show that when the electromagnetic pulse is reflected, the transient IMC omits basis functions defined over the last layers of the DBR, as anticipated. 

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