

The finite-difference time-domain (FDTD) method is an effective and widely used time-domain method for solving electromagnetic problems. Conventionally, its solutions are obtained numerically in a march-on-in-time manner. In this paper, based on the eigenmatrix theory, we derive the analytical expression for the FDTD solution. The FDTD solution is analytically expressed in terms of spatial modes modulated by discrete time sequences related to the eigenvalues of the FDTD system equation. Based on our results, we propose an alternative approach to the FDTD solutions and it could open a new horizon for applying advanced signal processing techniques as well as offering the possibility of storing the FDTD results in an analytical form for a structure after computation.