



# Simulation of Surface Plasmon-Polaritons in FDTD: Derivation and Investigation

*Ahmad Al-Jabr, Mohammad Alsunaidi*

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Surface Plasmon-Polaritons (SPPs) are a special form of electromagnetic (EM) waves that propagate in metallic nano-structures where EM waves can't propagate, overcoming the diffraction limit. Because of that, SPPs draw much attention of researchers from theoretical and experimental points of view. The finite difference time-domain (FDTD) is a numerical method that is extensively used to simulate and study SPPs. In this book, the simulation of SPPs is explained step by step. Starting with Maxwell's equations, a new algorithm is derived and implemented. This algorithm is capable of handling many dispersion relations used to model metal in FDTD like Drude, Lorentz and Debye models. The algorithm can handle single-pole and multi-pole dispersion relations in the same manner. Due to the generality of this algorithm we called it the general algorithm. It is tested against analytical results and proved excellent accuracy. The algorithm is then used to simulate propagation of SPPs in metal using different models. Also, different structures and different cases were studied.

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