

Problem #1: rcwa3d () Function

Write a generic function in MATLAB that performs rigorous coupled-wave analysis of 3D devices. Modify your code from Homework #11 to do this.

Use the following header for your program:

```
function DAT = rcwa3d(DEV, SRC)
% RCWA3D    3D Rigorous Coupled-Wave Analysis
%
% DAT = rcwa3d(DEV, SRC);
%
% INPUT ARGUMENTS
% =====
% DEV      Device Parameters
%   .L      Array containing layer thicknesses
%   .URC    Array of convolution matrices for permeability
%   .ERC    Array of convolution matrices for permittivity
%   .P      Number of spatial harmonics along x
%   .Q      Number of spatial harmonics along y
%   .Lx     Period along x
%   .Ly     Period along y
%   .ur1    Permeability in reflection region
%   .er1    Permittivity in reflection region
%   .ur2    Permeability in transmission region
%   .er2    Permittivity in transmission region
%
% SRC      Source Parameters
%   .lam0   Free space wavelength
%   .theta  Elevation angle of incidence
%   .phi    Azimuthal angle of incidence
%   .te     Complex amplitude of TE polarization
%   .tm     Complex amplitude of TM polarization
%
% OUTPUT ARGUMENTS
% =====
% DAT      Output Data
%   .RDE    Diffraction efficiencies of reflected spatial harmonics
%   .TDE    Diffraction efficiencies of transmitted spatial harmonics
%   .REF    Overall reflectance
%   .TRN    Overall transmittance
%
% Homework #12, Problem 1
% EE 5337 - COMPUTATIONAL ELECTROMAGNETICS
```

Problem #2: Benchmark rcwa3d ()

Benchmark your rcwa3d () function by replicating the results from the previous Homework.

Problem #3: Parameter Sweeps for 2D Gratings

Calculate and plot the reflectance, transmittance, and conservation of power for the triangular grating device in Lecture 22 for the following two cases: (1) $\epsilon_{r1}=1.0$, $\epsilon_{r2}=1.0$, and (2) $\epsilon_{r1}=2.0$, $\epsilon_{r2}=9.0$. Sweep wavelength from 1.0 cm to 5.0 cm in 500 steps using the same polarization as described in the notes. Generate your plot on a percent scale.

Problem #4: Parameter Sweeps for 1D Gratings

Reproduce the same four parameter sweeps from Homework #9 using RCWA instead of FDFD. Record and report the simulation times for FDFD and RCWA for both parameters sweeps. Be sure both methods are converged, use the same number of frequency points, and do not generate any graphics when timing the codes because this will throw off the true simulation time.