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function HW1_3femtot

% use finite element formulas to solve the scalar Helmholtz
% equation for EM fields in a dielectric slab
%
% June 25, 2018   A. F. Peterson


% read mesh from file 'inputfil.txt'

 n_nodes = dlmread('inputfil.txt','', [0,0,0,0]);

 x=dlmread('inputfil.txt','', [1,1,n_nodes,1]);

 nstart = n_nodes + 1;
 nend = nstart + n_nodes - 2;
 epsilon = dlmread('inputfil.txt','', [nstart,1,nend,1]);

% initialize variables

  k0 = 2*pi;
  n_unknowns = n_nodes;
  Z=zeros(n_unknowns);
  RHS=zeros(n_unknowns,1);

% fill global matrix

  for irow=1:n_unknowns

      if (irow == 1)
   deltaR = x(2) - x(1);
   Z(irow,irow) = -1./deltaR^2 + k0^2 * epsilon(irow)/3 - 1j*k0/
deltaR;
   Z(irow,irow+1) = 1./deltaR^2 + k0^2 * epsilon(irow)/6;

      elseif(irow == n_unknowns)
   deltaL = x(irow) - x(irow-1);
   Z(irow,irow-1) = 1./deltaL^2 + k0^2 * epsilon(irow-1)/6;
   Z(irow,irow) = -1./deltaL^2 + k0^2 * epsilon(irow-1)/3 - 1j*k0/
deltaR;

      else
   deltaR = x(irow+1) - x(irow);
   deltaL = x(irow) - x(irow-1);
   Z(irow,irow-1) = 1./deltaL^2 + k0^2 * epsilon(irow-1)/6;
   Z(irow,irow) = -2./deltaL^2 + k0^2 * (epsilon(irow-1) +
 epsilon(irow))/3;
   Z(irow,irow+1) = 1./deltaL^2 + k0^2 * epsilon(irow)/6;
      end
 end

% disp(Z);
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% fill excitation vector (right hand side)

 delta = x(2) - x(1);
 RHS(1) = -1j*2*k0/delta;  % assumes that incident Ey(a)=1

% solve system of equations

 E = Z\RHS;

% write fields to output file

 fid = fopen('outputfil.txt', 'wt');

 gamma = E(1)-1;
 mag=abs(gamma);
 phs=180*atan2(imag(gamma),real(gamma))/pi;
 str = ['reflection coeff = ',num2str(mag),' ',num2str(phs)];
 disp(str);
 fprintf(fid,'%50s\n\n',str);
 tau = E(n_unknowns);
 mag=abs(tau);
 phs=180*atan2(imag(tau),real(tau))/pi;
 str = ['transmission coeff = ',num2str(mag),' ',num2str(phs)];
 disp(str);
 fprintf(fid,'%44s\n\n',str);
 for irow=1:n_unknowns
         mag=abs(E(irow));
         phs=180*atan2(imag(E(irow)),real(E(irow)))/pi;
         fprintf(fid,'%6d %15.14g %15.14g\n',irow, mag, phs);

 end

 fclose(fid);

end
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Published with MATLAB® R2018a