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function cavityTMQ
% compute propagation constants for waveguide cross section modeled
% with
% triangular cells
%
% September 23, 2018 A. F. Peterson

global pzetond xy;
global icell;

nnodes = dlmread('cylfil.txt','', [0,0,0,0]);
ncells = dlmread('cylfil.txt','', [0,1,0,1]);
ninner = dlmread('cylfil.txt','', [0,2,0,2]);
nouter = dlmread('cylfil.txt','', [0,3,0,3]);
xy=dlmread('cylfil.txt','', [1,0,nnodes,1]);
nstart=nnodes + 1;
nend=nstart + ncells - 1;
pzetond=dlmread('cylfil.txt','', [nstart,0,nend,5]);

nstart=nend + 1;
nend=nstart + ninner - 1;
% pinner=dlmread('cylfil.txt','', [nstart,0,nend,0]);

nstart=nend + 1;
nend=nstart + nouter - 1;
% pouter=dlmread('cylfil.txt','', [nstart,0,nend,0]);

nstart=nend + 1;
nend=nstart + ncells - 1;
er=dlmread('cylfil.txt','', [nstart,0,nend,0]);

% initialize variables
rerr = 1.0e-8;
aerr = 1.0e-12;
nunks = nnodes - ninner - nouter;
W=zeros(nunks);
Y=zeros(nunks);

% loop through the cells, filling global matrix one cell at a time

for icell=1:ncells

    %    compute 6 by 6 element matrix for cell 'icell'

    [eleS,eleT] = elemat(rerr,aerr);

    %    add contributions from cell 'icell' to global matrices

    for ii=1:6
        for jj=1:6
            ig=pzetond(icell,ii); % 'ig' is the global node for 'ii'
            if(ig <= nunks) % test function at interior node

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        jg=pcetond(icell,jj); % 'jg' is the global node for
    'jj'
        if(jg <= nunks) % basis function at interior node
            W(ig,jg) = W(ig,jg) + er(icell)*eleS(ii,jj);
            Y(ig,jg) = Y(ig,jg) + er(icell)*eleT(ii,jj);
        end
    end
end
end
end

% write results to file 'eigfil.txt'
fid = fopen('eigfil.txt', 'wt');
E = eig(W,Y); % use [V,E] = eig(W,Y) to get eigenvectors as well

str = 'TM resonant wavenumbers: ';
fprintf(fid,'%s \n',str);
for ii=1:nunks
    reaE=real(sqrt(E(ii)));
    imaE=imag(sqrt(E(ii)));
    fprintf(fid,'%6d %15.14g %15.14g\n',ii, reaE,imaE);
end
end

%
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function [eleS,eleT] = elemat(rerr,aerr)

% elemat: construct the 6 by 6 element matrices for the contributions
% of
%     basis and testing functions of the form
%     grad T dot grad B      and      T times B
%     over a triangular cell
%
%     done by quadrature over integrands 'Sint' and 'Tint'

global itest ibasis;
eleS(6,6)=0; eleT(6,6)=0;

% compute 6 by 6 element matrices S, T
for ii=1:6
    itest=ii;
    for jj=1:6
        ibasis=jj;
        eleS(ii,jj)=rtriad('Sint',rerr,aerr);
        eleT(ii,jj)=rtriad('Tint',rerr,aerr);
    end
end
end
end

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