ELCE 702 HW02 End

M-B5-5515-2 Tang Qi

Q1：Conjugate gradient method to solve Ax=b, by MATLAB:

>> clear

>>

A1=[4,-1,0,0; -1,4,-1,0; 0,-1,4,-1; 0,0,-1,4];

negI=[-1,0,0,0; 0,-1,0,0; 0,0,-1,0; 0,0,0,-1];

Emp=[0,0,0,0; 0,0,0,0; 0,0,0,0; 0,0,0,0];

A=[A1,negI,Emp,Emp;negI,A1,negI,Emp;Emp,negI,A1,negI;Emp,Emp,negI,A1];

b=[1;2;3;4;5;6;7;8;9;0;1;2;3;4;5;6];

Tol = 0.05;

x0 = zeros(length(b), 1);

x = x0; % Initialize x

k = 1;

r = A\*x - b; % Initialize residuals

p = -r; % Initialize conjugate direction

deltaNew = r'\*r; % deltaNew is the square error

delta0 = deltaNew; % initial square error

OriX = A\b;

while (norm(r,inf)> Tol)

q = A\*p;

alpha = deltaNew/(p'\*q); % update step size

x = x + alpha\*p; % Update x

r = r + alpha\*q; % update residuals

deltaOld = deltaNew; % save previous square error

deltaNew = r'\*r; % Update square error

p = -r + (deltaNew/deltaOld)\*p; % Update conjugate direction

k = k + 1; % Increment iteration count

end

k

x

% Check accuracy

r

k =

7

x =

2.5533

4.0884

4.6086

3.6443

5.1416

7.1976

7.6827

5.9343

5.8191

5.8542

5.9419

4.4235

3.3226

4.4935

4.8066

3.8090

r =

-0.0167

-0.0058

0.0191

0.0343

-0.0034

0.0232

0.0484

-0.0134

-0.0421

-0.0350

0.0005

0.0088

-0.0220

-0.0096

-0.0181

0.0060

>>

Q2. Stability of three 10\*10 matrixes:

>> clear

>> a=0.25;b=0.5;c=0.75;

a1=1.5;a2=2;a3=2.5;

m=a1; % or a2, a3

n=-a; % or -b, -c

v=[m m m m m m m m m m];w=[n n n n n n n n n];

X=diag(v);Y=diag(w,-1);Z=diag(w,+1);

A=X+Y+Z;

invA= inv(A);

SR=max(abs(eig(invA))) % find the spectrum density "rou", for three A's

p=ones(10,1);

q=p;

step=0;

% do approximation for spectral density

while abs(max(q)-SR)>(10^-10)

q=invA\*p;

p=q/max(q);

step=step+1;

end

step

format long

max(q)

SR =

0.980148548443249

step =

143

ans =

0.980148548539887

>>

For a=0.25, we can see the spectral density to be 0.98014854844324 from above program. To get the tolerance of the approximation with in 10^(-10), it takes 143 steps.

Similarly, for b=0.5:

SR =

0.961069915571627

step =

80

And for c=0.75:

SR =

0.942719834202721

step =

59