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close all
clear all
rand('seed',0);
rng(0,'twister')

n=1000;
%%% define matrix
P='problem1';
[A,b,Lambda]=feval(P,n);

% P='problem3';
% [A,b]=feval(P,1000)

n=size(b,1);

%%% redefine righthand side vector
x=rand(n,1);
b=feval(A,x); b=b/norm(b);

%%% Is an interval Lambda that contains all eigenvalues available?
INTERVAL=exist('Lambda');
if INTERVAL, INTERVAL=(INTERVAL & length(Lambda)>1); end

if INTERVAL
    ell=20;
    x=cos(((1:ell)-0.5)*pi/ell);
    %%% shift to interval that contains the eigenvalues
    Lmin=min(Lambda); Lmax=max(Lambda); %%% spectral ends
    mu=0.5*(Lmax+Lmin); %%% centre spectrum
    radius=0.5*(Lmax-Lmin); %%% radius spectrum
    %%% shift x to the zeros to the interval Lambda that contains the eigenvalues
    Mu=mu-radius*x;
    %%% sort Mu
    I=myorder(Mu); Mu=Mu(I);
end

if 0
    NameMatrix='meier01';
    % NameMatrix='vdvorst3';
    % NameMatrix='Grond4e4';
    % NameMatrix='saad3';
    % NameMatrix='hybrid92';
    NameMatrix='tfqmr001';
    % NameMatrix='sherman1';
    % NameMatrix='pde900';
    [A,b,hbtype]=matrixhbo(NameMatrix); b=b(:,1); n=size(b,1);
    fprintf(1,'\n\n%s: %d by %d matrix of type %s\n\n',NameMatrix,n,n,hbtype)
end
if isempty(b), b=rand(n,1); end
b=b(:,1);

tol=1.0e-10;
kmax=6000;

myplot();
Methods=strvcat('Rich','LMR','ChebFix','Cheb','GCR');
Methods=strvcat('ChebFix','Cheb','GCRr','GMRES','FOM','cg','bicg');
Methods=strvcat('GCRr','GMRES','FOM','bicg','bicgstabl');

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% Methods=strvcat('GMRES','bicg','bicgstab','bicgstabl','cgs');
L=4;

for k=1:size(Methods,1)
    %%% Solve

    method=lower(deblank(Methods(k,:)));

    if strcmp(method,'rich')
        %%% Polynomial solvers
        [x,hist,t,NoMV]=polynomialssolver(A,b,0*b,tol,kmax,401/2);
        myplot(A,b,x,hist,t,NoMV,method,'b');
    end

    if strcmp(method,'lmr')
        %%% LMR
        [x,hist,t,NoMV]=polynomialssolver(A,b,0*b,tol,kmax);
        myplot(A,b,x,hist,t,NoMV,method,'r');
    end

    if strcmp(method,'chebfix')
        %%% Chebyshev fixed polynomial
        [x,hist,t,NoMV]=polynomialssolver(A,b,0*b,tol,kmax,Mu);
        method=sprintf('Cheb(%d)',length(Mu));
        myplot(A,b,x,hist,t,NoMV,method,'m');
    end

    if strcmp(method,'cheb')
        %%% Chebyshev (three-term recurrence)
        [x,hist,t,NoMV]=chebyshev(A,b,0*b,mu,radius,tol,kmax);
        myplot(A,b,x,hist,t,NoMV,method,'g');
    end

    str='gcr';
    if strcmp(method,str)
        %%% GCR
        [x,hist,t,NoMV]=feval(str,A,b,0*b,tol,kmax);
        myplot(A,b,x,hist,t,NoMV,method,'k');
    end

    str='gcurr';
    if strcmp(method,str)
        %%% GCRr
        [x,hist,t,NoMV]=feval(str,A,b,0*b,tol,kmax,[],7);
        myplot(A,b,x,hist,t,NoMV,method,'b');
    end

    str='gmres';
    if strcmp(method,str)
        %%% GMRES
        [x,hist,t,NoMV]=feval(str,A,b,0*b,tol,300);
        myplot(A,b,x,hist,t,NoMV,method,'k');
    end

    if strcmp(method,'fom')
        %%% FOM
        [x,hist,t,NoMV]=gmres(A,b,0*b,tol,kmax,'FOM');
        myplot(A,b,x,hist,t,NoMV,method,'r');
    end
end

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str='cg';
if strcmp(method,str)
    %%% CG
    [x,hist,t,NoMV]=feval(str,A,b,0*b,tol,kmax);
    myplot(A,b,x,hist,t,NoMV,method,'m');
end

str='bicg';
if strcmp(method,str)
    %%% Bi-CG
    [x,hist,t,NoMV]=feval(str,A,b,0*b,tol,kmax);
    myplot(A,b,x,hist,t,NoMV,method,'g');
end

str='bicgstab';
if strcmp(method,str)
    %%% Bi-CGSTAB
    [x,hist,t,NoMV]=feval(str,A,b,0*b,tol,kmax);
    myplot(A,b,x,hist,t,NoMV,method,'k');
end

str='bicgstabl';
if strcmp(method,str)
    %%% Bi-CGSTAB(ell)
    [x,hist,t,NoMV]=feval(str,A,b,0*b,tol,kmax,L);
    method=sprintf('bicgstab(%d)',L);
    myplot(A,b,x,hist,t,NoMV,method,'b');
end

str='cgs';
if strcmp(method,str)
    %%% CGS
    [x,hist,t,NoMV]=feval(str,A,b,0*b,tol,kmax);
    myplot(A,b,x,hist,t,NoMV,method,'r');
end

end

myplot(A,b)

zoom on
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