clc

clear;

Y\_Bus=[6.03-19.45i -5+15.26i 0 0 -1.03+4.23i 0 0 0 0 0 0 0 0 0;

-5+15.26i 9.52-30.27i -1.14+4.78i -1.69+5.12i -1.7+5.19i 0 0 0 0 0 0 0 0 0;

0 -1.14+4.78i 3.12-9.82i -1.99+5.07i 0 0 0 0 0 0 0 0 0 0;

0 -1.69+5.12i -1.99+5.07i 10.5157-38.6542i -6.8410+21.5786i 0 -0.0023+4.8895i 0 -0.0003+1.8555i 0 0 0 0 0;

-1.03+4.23i -1.7+5.19i 0 -6.84+21.58i 9.5698-35.5336i -0.0017+4.2574i 0 0 0 0 0 0 0 0;

0 0 0 0 -0.0017+4.2574i 6.5815-17.3407i 0 0 0 0 -1.96+4.09i -1.53+3.18i -3.1+6.10i 0;

0 0 0 -0.0023+4.8895i 0 0 0.0138+-19.5490i -0.0032+5.6770i -0.0083+9.0901i 0 0 0 0 0;

0 0 0 0 0 0 -0.0032+5.6770i 0.0032+-5.6770i 0 0 0 0 0 0;

0 0 0 -0.0003+1.8555i 0 0 -0.0083+9.0901i 0 5.3346-24.0925i -3.9+10.37i 0 0 0 -1.42+3.03i;

0 0 0 0 0 0 0 0 -3.9+10.37i 5.78-14.77i -1.88+4.4i 0 0 0;

0 0 0 0 0 -1.96+4.09i 0 0 0 -1.88+4.4i 3.84-8.5i 0 0 0;

0 0 0 0 0 -1.53+3.18i 0 0 0 0 0 4.01-5.43i -2.49+2.25i 0;

0 0 0 0 0 -3.1+6.10i 0 0 0 0 0 -2.49+2.25i 6.72-10.67i -1.14+2.31i;

0 0 0 0 0 0 0 0 -1.42+3.03i 0 0 0 -1.14+2.31i 2.56-5.34i];

B=eye(14);

for j=1:14

Y(:,:,j)=B(:,j)\*B(j,:)\*Y\_Bus;

%disp(Y(:,:,j));

Y\_n\_a(:,:,j)=0.5\*[real(Y(:,:,j)+transpose(Y(:,:,j))) imag(transpose(Y(:,:,j))-Y(:,:,j));

imag(Y(:,:,j)-transpose(Y(:,:,j))) real(Y(:,:,j)+transpose(Y(:,:,j)))];

Y\_n\_r(:,:,j)=-0.5\*[imag(Y(:,:,j)+transpose(Y(:,:,j))) real(Y(:,:,j)-transpose(Y(:,:,j)));

real(transpose(Y(:,:,j))-Y(:,:,j)) imag(Y(:,:,j)+transpose(Y(:,:,j)))];

%disp(Y\_net\_act(:,:,j));

%disp(Y\_net\_react(:,:,j));

M(:,:,j)=[B(:,j)\*B(j,:) zeros(14,14);zeros(14,14) B(:,j)\*B(j,:)];

end

Y\_act=[Y\_n\_a(:,:,1) Y\_n\_a(:,:,2) Y\_n\_a(:,:,3) Y\_n\_a(:,:,4) Y\_n\_a(:,:,5) Y\_n\_a(:,:,6) Y\_n\_a(:,:,7) Y\_n\_a(:,:,8) Y\_n\_a(:,:,9) Y\_n\_a(:,:,10) Y\_n\_a(:,:,11) Y\_n\_a(:,:,12) Y\_n\_a(:,:,13) Y\_n\_a(:,:,14)];

Y\_react=[Y\_n\_r(:,:,1) Y\_n\_r(:,:,2) Y\_n\_r(:,:,3) Y\_n\_r(:,:,4) Y\_n\_r(:,:,5) Y\_n\_r(:,:,6) Y\_n\_r(:,:,7) Y\_n\_r(:,:,8) Y\_n\_r(:,:,9) Y\_n\_r(:,:,10) Y\_n\_r(:,:,11) Y\_n\_r(:,:,12) Y\_n\_r(:,:,13) Y\_n\_r(:,:,14)];

M\_net=[M(:,:,1) M(:,:,2) M(:,:,3) M(:,:,4) M(:,:,5) M(:,:,6) M(:,:,7) M(:,:,8) M(:,:,9) M(:,:,10) M(:,:,11) M(:,:,12) M(:,:,13) M(:,:,14)];

P\_k\_Max=[3.324;1.4;0;0;0;0;0;0;0;0;0;0;0;0];

P\_k\_Min=[0;0;0;0;0;0;0;0;0;0;0;0;0;0];

Q\_k\_Max=[.10;.5;.4;0;0;.24;0;.24;0;0;0;0;0;0];

Q\_k\_Min=[-.2;-.4;0;0;0;-.06;0;-.06;0;0;0;0;0;0];

V\_k\_Max=[1.06;1.06;1.06;1.06;1.06;1.06;1.06;1.06;1.06;1.06;1.06;1.06;1.06;1.06];

V\_k\_Min=[0.94;0.94;0.94;0.94;0.94;0.94;0.94;0.94;0.94;0.94;0.94;0.94;0.94;0.94];

V\_k\_M=V\_k\_Max.\*V\_k\_Max;

V\_k\_m=V\_k\_Min.\*V\_k\_Min;

P\_d\_k=[0;.217;.942;.478;.076;.112;0;0;.295;.09;.035;.061;.135;.149];

Q\_d\_k=[0;.127;.190;-.039;.016;.075;0;0;-.024;.058;.018;.016;.058;.05];

c12=0.0430293;c11=20;c10=0;c22=.25;c21=20;c20=0;

cvx\_begin

variables lambdak\_m(14) lambdak\_M(14) lambda\_k\_m(14) lambda\_k\_M(14) mu\_k\_M(14) mu\_k\_m(14);

variables r\_1\_1 r\_1\_2 r\_2\_1 r\_2\_2;

dual variable A;

maximize transpose(lambdak\_m)\*P\_k\_Min-transpose(lambdak\_M)\*P\_k\_Max+transpose(lambdak\_M-lambdak\_m)\*P\_d\_k+transpose(lambda\_k\_m)\*Q\_k\_Min-transpose(lambda\_k\_M)\*Q\_k\_Max+transpose(lambda\_k\_M-lambda\_k\_m)\*Q\_d\_k+transpose(mu\_k\_m)\*V\_k\_m-transpose(mu\_k\_M)\*V\_k\_M+c10+c20-r\_1\_2-r\_2\_2+(c11+2\*sqrt(c12)\*r\_1\_1)\*P\_d\_k(1)+(c21+2\*sqrt(c22)\*r\_2\_1)\*P\_d\_k(2);

%minimize -(transpose(lambda\_k\_M)\*Q\_k\_Max);

subject to

lambdak\_m>=0;

lambdak\_M>=0;

lambda\_k\_m>=0;

lambda\_k\_M>=0;

mu\_k\_M>=0;

mu\_k\_m>=0;

[1 r\_1\_1;r\_1\_1 r\_1\_2]==semidefinite(2);

[1 r\_2\_1;r\_2\_1 r\_2\_2]==semidefinite(2);

M\_net\*kron((mu\_k\_M-mu\_k\_m),eye(28))+Y\_react\*kron((lambda\_k\_M-lambda\_k\_m),eye(28))+Y\_act\*kron((lambdak\_M-lambdak\_m),eye(28))+(c11+2\*sqrt(c12)\*r\_1\_1)\*Y\_n\_a(:,:,1)+(c21+2\*sqrt(c22)\*r\_2\_1)\*Y\_n\_a(:,:,2)==semidefinite(28):A;

cvx\_end

disp(lambdak\_m);

disp(lambdak\_M);

disp(lambda\_k\_m);

disp(lambda\_k\_M);

disp(mu\_k\_M);

disp(mu\_k\_m);

disp(cvx\_slvitr);

disp(cvx\_slvtol);

%disp([1 r\_1\_1;r\_1\_1 r\_1\_2]);

%disp([1 r\_2\_1;r\_2\_1 r\_2\_2]);

%disp(M\_net\*kron((mu\_k\_M-mu\_k\_m),eye(28))+Y\_react\*kron((lambda\_k\_M-lambda\_k\_m),eye(28))+Y\_act\*kron((lambdak\_M-lambdak\_m),eye(28))+(c11+2\*sqrt(c12)\*r\_1\_1)\*Y\_n\_a(:,:,1)+(c21+2\*sqrt(c22)\*r\_2\_1)\*Y\_n\_a(:,:,2));

disp(eig(M\_net\*kron((mu\_k\_M-mu\_k\_m),eye(28))+Y\_react\*kron((lambda\_k\_M-lambda\_k\_m),eye(28))+Y\_act\*kron((lambdak\_M-lambdak\_m),eye(28))+(c11+2\*sqrt(c12)\*r\_1\_1)\*Y\_n\_a(:,:,1)+(c21+2\*sqrt(c22)\*r\_2\_1)\*Y\_n\_a(:,:,2)));

disp(min(eig(M\_net\*kron((mu\_k\_M-mu\_k\_m),eye(28))+Y\_react\*kron((lambda\_k\_M-lambda\_k\_m),eye(28))+Y\_act\*kron((lambdak\_M-lambdak\_m),eye(28))+(c11+2\*sqrt(c12)\*r\_1\_1)\*Y\_n\_a(:,:,1)+(c21+2\*sqrt(c22)\*r\_2\_1)\*Y\_n\_a(:,:,2))));

disp(rank(A));