

```

function y=range2vector(x,minmax,N,n,l)
    if minmax==-1
        y = min(x');
    else
        y = max(x');
    end
    y = y.*ones(n*1,1);
    y = reshape(y,N*n*1,1);
end

function y=constant2vector(x,N,n,l)
    y = x';
    y = y.*ones(n*1,1);
    y = reshape(y,N*n*1,1);
end

function y=directSum(A,B)
    [ax,ay] = size(A);
    [bx,by] = size(B);
    y = [A zeros(ax,by);zeros(bx,ay) B];
end

function y=thingy(x,l)
    [X,Y]=meshgrid(1:l);
    y = zeros(l,1);
    y(Y>=X)=x;
end
thingy(1,4)

```

```

ans = 4x4
     1     0     0     0
     1     1     0     0
     1     1     1     0
     1     1     1     1

```

```

function y=HMatrix(x,N,n,l,b_ij)
    temp = 1:l;
    y = [];
    for i=1:N
        index = zeros(l,1);
        index(temp>=x(i,1))=1;
        index(temp>x(i,2))=0;
        BD=thingy(b_ij(i,i),l)*diag(index);
        for j=1:n
            y = directSum(y,BD);
        end
    end
end
% HMatrix(aidi,N,n,l,b_ij);

```

Assume $\Delta\eta = 0.25$

```
% clearvars;
```

```
N = 5
```

```
N = 5
```

```
n = 5
```

```
n = 5
```

```
l = 5
```

```
l = 5
```

```
SOCrange = [0.1 1;0.1 1;0.1 1;0.1 1;0.1 1]
```

```
SOCrange = 5x2
```

```
0.1000    1.0000
0.1000    1.0000
0.1000    1.0000
0.1000    1.0000
0.1000    1.0000
```

```
Irange = [0 12;0 15;0 15;0 15;0 20]
```

```
Irange = 5x2
```

```
0    12
0    15
0    15
0    15
0    20
```

```
Vrange = [3.2 5;3.2 5;3.2 5;3.2 5;3.2 5]
```

```
Vrange = 5x2
```

```
3.2000    5.0000
3.2000    5.0000
3.2000    5.0000
3.2000    5.0000
3.2000    5.0000
```

```
f = [3.8; 4; 4.2; 4.1;3.6];
```

```
y = [0.04; 0.05; 0.08; 0.06; 0.03];
```

```
w = [-22.6; -20; -13.8; -18.8; -27]
```

```
w = 5x1
```

```
-22.6000
-20.0000
-13.8000
-18.8000
-27.0000
```

```
% temp = -0.25*f.*f./y
```

```
% temp./w
```

```
v = [50; 40; 25; 33.3; 66.7]
```

```
v = 5×1
    50.0000
    40.0000
    25.0000
    33.3000
    66.7000
```

```
% temp = 2./y

SOCmin = range2vector(SOCrange,-1,N,n,1);
SOCmax = range2vector(SOCrange,1,N,n,1);

Imin = range2vector(Irange,-1,N,n,1);
Imax = range2vector(Irange,1,N,n,1);

Vmin = range2vector(Vrange,-1,N,n,1);
Vmax = range2vector(Vrange,1,N,n,1);

fi = constant2vector(f,N,n,1);
yi = constant2vector(y,N,n,1);
ki = -0.5*fi./yi;
yi = diag(yi);
wi = constant2vector(w,N,n,1);
vi = constant2vector(v,N,n,1);
vi = diag(vi);
```

```
D = diag([2 3 2 2 1]);
A = [0 1 0 0 1;1 0 1 1 0;0 1 0 1 0;0 1 1 0 0;1 0 0 0 0];
L = D-A;
```

```
SOCin = SOCmin;
Iin = zeros(N*n*1,1);
```

$$\mu = 0.95$$

$$\Delta = 4$$

```
aidi = [1 3;2 4;2 5;1 4;4 5]
```

```
aidi = 5×2
     1     3
     2     4
     2     5
     1     4
     4     5
```

```
qi = [1;2;3;4;5];
qij = ones(1,n).*qi;
muDelta = 0.95*4;
b_ij = muDelta./qij;
H = HMatrix(aidi,N,n,1,b_ij);
```

```
rank(H)
```

```
ans = 80
```

```
size(H)
```

```
ans = 1×2  
125 125
```

ADMM

Initialization

```
rng(242)  
rho=1.6;  
I0 = Iin;  
lambda0 = randi([0,10],size(Imin));  
S_ij0 = randi([0,10],size(Imin));  
beta0 = zeros(N*n*1,1);  
design = 2;  
tol = 1e-5;  
max_iter=10;  
converged = false;  
  
viVector = diag(vi);  
viVector = reshape(viVector,25,5);  
  
sig_min = SOCmin-SOCin;  
sig_max = SOCmax-SOCin;  
  
del_min = Vmin - fi;  
del_max = Vmax - fi;  
  
IminActual = max(Imin,max(pinv(H)*sig_min,yi\del_min));  
ImaxActual = min(Imax,min(pinv(H)*sig_max,yi\del_max));
```

Iteration

```
for i=1:max_iter  
    betaTemp = reshape(beta0,25,5);  
    graphtemp = design*betaTemp*L./viVector;  
    graphtemp1 = reshape(graphtemp,N*n*1,1);  
    beta1 = vi\((rho*vi+ones(size(vi)))*I0 + vi*(lambda0-rho.*S_ij0)-ki)-graphtemp1;  
    I1 = I0 - reshape(graphtemp.*viVector,[],1);  
    S_ij1 = I1 + lambda0/rho;  
    S_ij1(S_ij1<IminActual)=IminActual(S_ij1<IminActual);  
    S_ij1(S_ij1>ImaxActual)=ImaxActual(S_ij1>ImaxActual);  
    lambda1 = lambda0 + rho*(I1-S_ij1);  
    if norm(S_ij1-S_ij0)<tol
```

```

        converged = true;
        break;
    end
    beta0 = beta1;
    I0 = I1;
    S_ij0 = S_ij1;
    lambda0 = lambda1;
end

```

I0

```

I0 = 125x1
107 ×
    0.2129
    0.0273
   -0.1379
    0.2082
   -0.1971
    0.0089
    0.6247
   -0.9523
   -0.1267
   -0.1722
    ⋮

```