
Homework #5

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Baseline

```
%Prepare the workspace
% Read in data
clearvars
ele=dlmread('epeltr4.dat.txt');
nod=dlmread('npeltr4.dat.txt');
bc=dlmread('bpeltr4.dat.txt');
pd=dlmread('ppelt4.dat.txt');
% input guass point
a=0.577350269189626;
z=[-a,a,a,-a];
%z=-a;
e=[-a,-a,a,a];
%e=-a;
w=1;
clear a
% element matrix assembly
%k=1;
a_mat=zeros(length(nod));
b_ray=zeros(length(nod),1);
ct_r=0;
ct_t=0;
for k=1:length(ele)
    e_nod=ele(k,2:5);
    sig_e=-pd(k,3);
    tt=ele(k,6);
    e_char=ele(k,6);
    tp_k=[0,0,0.21,0.642,0.436,0.561,0.515,0.642];
    tp_m=[0,0,200,2001.4,0,0,1482.5,0];
    xl=(nod(e_nod,2))';
    yl=(nod(e_nod,3))';
    a_e=zeros(4);
    re=zeros(1,4);
    if e_nod(3)~=e_nod(4)
        %bilinear
        ct_r=ct_r+1;
        for m=1:4
            %for m=1
            [p,dpx,dpy,dj]=basis_gen(z(m),e(m),xl,yl);
            km=sum(tp_k(tt)*p);
            fm=sum(tp_m(tt)*p);
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        %gm=sum(sig_e*p);
        for i=1:4
            for j=1:4
                a_e(i,j)=a_e(i,j)+dj*1*(-
km*(dpx(i)*dpx(j)+dpy(i)*dpy(j))-fm*p(i)*p(j));
                end
                re(i)=re(i)+dj*1*sig_e*p(i);
            end
        end
        for i=1:4
            for j=1:4

a_mat(e_nod(i),e_nod(j))=a_mat(e_nod(i),e_nod(j))+a_e(i,j);
                end
                b_ray(e_nod(i),1)=b_ray(e_nod(i),1)+re(i);
            end
        end
        end
        if e_nod(3)==e_nod(4)
            %triangle
            ct_t=ct_t+1;
            x_e=nod(e_nod,2);
            y_e=nod(e_nod,3);
            delt_x(1)=x_e(2)-x_e(3);
            delt_x(2)=x_e(3)-x_e(1);
            delt_x(3)=x_e(1)-x_e(2);
            delt_y(1)=y_e(2)-y_e(3);
            delt_y(2)=y_e(3)-y_e(1);
            delt_y(3)=y_e(1)-y_e(2);

            a_area=0.5*(x_e(1)*delt_y(1)+x_e(2)*delt_y(2)+x_e(3)*delt_y(3));
            for i=1:3
                for j=1:3
                    if i==j
                        amat_e(i,j)=-
tp_k(tt)*(delt_x(i)*delt_x(j)+delt_y(i)*delt_y(j))/(4*a_area)-
tp_m(tt)*a_area/6;
                    else
                        amat_e(i,j)=-
tp_k(tt)*(delt_x(i)*delt_x(j)+delt_y(i)*delt_y(j))/(4*a_area)-
tp_m(tt)*a_area/12;
                    end
                end
            end

            a_mat(e_nod(i),e_nod(j))=a_mat(e_nod(i),e_nod(j))+amat_e(i,j);
                end
                b_e(i)=sig_e*a_area/3;
                b_ray(e_nod(i),1)=b_ray(e_nod(i),1)+b_e(i);
            end
        end
        end
        % modify the a_mat and b_ray for type 3 boundary condition
        b1=bc(:,2);
        b2=bc(:,4);
        b3=bc(:,5);
        h=bc(:,6);

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ta=bc(:,7);
for k=1:length(bc)
    x1=nod(b1(k),2);
    y1=nod(b1(k),3);
    x2=nod(b2(k),2);
    y2=nod(b2(k),3);
    x3=nod(b3(k),2);
    y3=nod(b3(k),3);
    len1=sqrt((x1-x2)^2+(y1-y2)^2);
    len2=sqrt((x1-x3)^2+(y1-y3)^2);
    a_mat(b1(k),b1(k))=a_mat(b1(k),b1(k))-h(k)*(len1+len2)/3;
    a_mat(b1(k),b2(k))=a_mat(b1(k),b2(k))-h(k)*(len1)/6;
    a_mat(b1(k),b3(k))=a_mat(b1(k),b3(k))-h(k)*(len2)/6;
    b_ray(b1(k))=b_ray(b1(k))-h(k)*ta(k)*(len1+len2)/2;
end
%
u=a_mat\b_ray;
%
figure();
for i=1:size(ele,1)
    if ele(i,6)==8
        if ele(i,4)==ele(i,5)

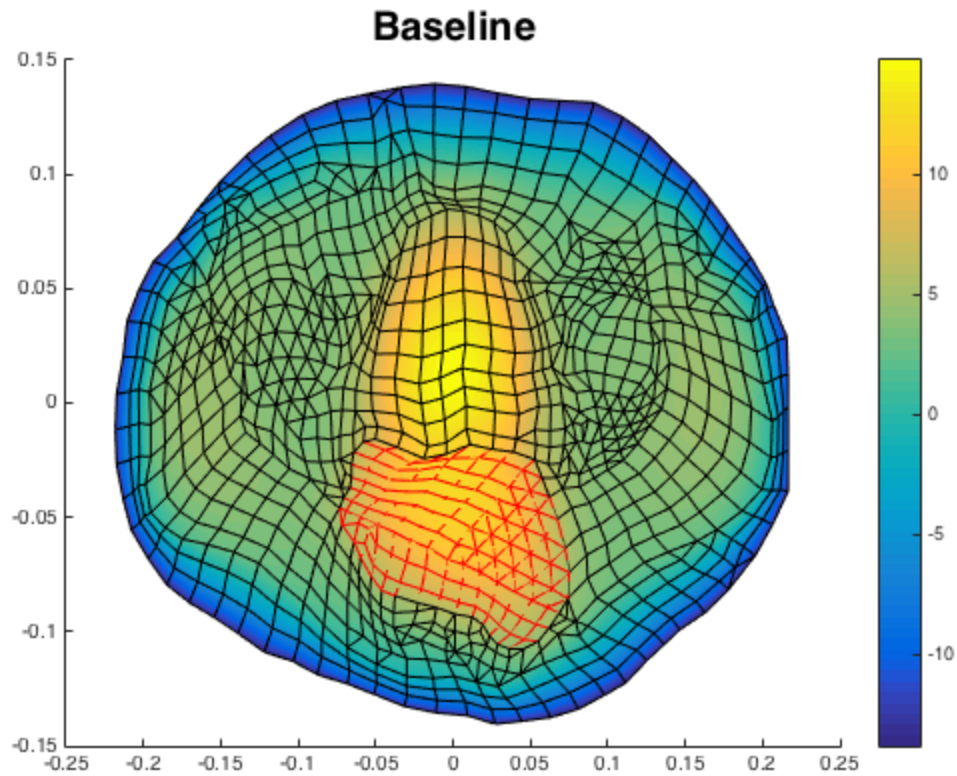
            patch(nod(ele(i,2:4),2),nod(ele(i,2:4),3),u(ele(i,2:4)),'FaceColor','interp','EdgeColor','none');
                hold on;
            else

            patch(nod(ele(i,2:5),2),nod(ele(i,2:5),3),u(ele(i,2:5)),'FaceColor','interp','EdgeColor','none');
                hold on;
            end
        else
            if ele(i,4)==ele(i,5)

            patch(nod(ele(i,2:4),2),nod(ele(i,2:4),3),u(ele(i,2:4)),'FaceColor','interp','EdgeColor','none');
                hold on;
            else

            patch(nod(ele(i,2:5),2),nod(ele(i,2:5),3),u(ele(i,2:5)),'FaceColor','interp','EdgeColor','none');
                hold on;
            end
        end
    end
end
title('Baseline','fontsize',20);
colorbar;

```



Increased blood flow

```

%Prepare the workspace
% Read in data
clearvars
ele=dlmread('epeltr4.dat.txt');
nod=dlmread('npeltr4.dat.txt');
bc=dlmread('bpeltr4.dat.txt');
pd=dlmread('ppelt4.dat.txt');
% input guass point
a=0.577350269189626;
z=[-a,a,a,-a];
%z=-a;
e=[-a,-a,a,a];
%e=-a;
w=1;
clear a
% element matrix assembly
%k=1;
a_mat=zeros(length(nod));
b_ray=zeros(length(nod),1);
ct_r=0;
ct_t=0;
for k=1:length(ele)
    e_nod=ele(k,2:5);

```

```

sig_e=-pd(k,3);
tt=ele(k,6);
e_char=ele(k,6);
tp_k=[0,0,0.21,0.642,0.436,0.561,0.515,0.642];
tp_m=[0,0,200,2001.4,0,2001.4/2,1482.5,0];
xl=(nod(e_nod,2))';
yl=(nod(e_nod,3))';
a_e=zeros(4);
re=zeros(1,4);
if e_nod(3)~=e_nod(4)
    ct_r=ct_r+1;
    for m=1:4
        %for m=1
        [p,dpx,dpy,dj]=basis_gen(z(m),e(m),xl,yl);
        km=sum(tp_k(tt)*p);
        fm=sum(tp_m(tt)*p);
        %gm=sum(sig_e*p);
        for i=1:4
            for j=1:4
                a_e(i,j)=a_e(i,j)+dj*1*(-
km*(dpx(i)*dpx(j)+dpy(i)*dpy(j))-fm*p(i)*p(j));
            end
            re(i)=re(i)+dj*1*sig_e*p(i);
        end
    end
    for i=1:4
        for j=1:4

a_mat(e_nod(i),e_nod(j))=a_mat(e_nod(i),e_nod(j))+a_e(i,j);
        end
        b_ray(e_nod(i),1)=b_ray(e_nod(i),1)+re(i);
    end
end
if e_nod(3)==e_nod(4)
    ct_t=ct_t+1;
    x_e=nod(e_nod,2);
    y_e=nod(e_nod,3);
    delt_x(1)=x_e(2)-x_e(3);
    delt_x(2)=x_e(3)-x_e(1);
    delt_x(3)=x_e(1)-x_e(2);
    delt_y(1)=y_e(2)-y_e(3);
    delt_y(2)=y_e(3)-y_e(1);
    delt_y(3)=y_e(1)-y_e(2);

a_area=0.5*(x_e(1)*delt_y(1)+x_e(2)*delt_y(2)+x_e(3)*delt_y(3));
    for i=1:3
        for j=1:3
            if i==j
                amat_e(i,j)=-
tp_k(tt)*(delt_x(i)*delt_x(j)+delt_y(i)*delt_y(j))/(4*a_area)-
tp_m(tt)*a_area/6;
            else

```

```

        amat_e(i,j)=-
tp_k(tt)*(delt_x(i)*delt_x(j)+delt_y(i)*delt_y(j))/(4*a_area)-
tp_m(tt)*a_area/12;
        end

a_mat(e_nod(i),e_nod(j))=a_mat(e_nod(i),e_nod(j))+amat_e(i,j);
        end
        b_e(i)=sig_e*a_area/3;
        b_ray(e_nod(i),1)=b_ray(e_nod(i),1)+b_e(i);
        end
    end
end
% modify the a_mat and b_ray for type 3 boundary condition
b1=bc(:,2);
b2=bc(:,4);
b3=bc(:,5);
h=bc(:,6);
ta=bc(:,7);
for k=1:length(bc)
    x1=nod(b1(k),2);
    y1=nod(b1(k),3);
    x2=nod(b2(k),2);
    y2=nod(b2(k),3);
    x3=nod(b3(k),2);
    y3=nod(b3(k),3);
    len1=sqrt((x1-x2)^2+(y1-y2)^2);
    len2=sqrt((x1-x3)^2+(y1-y3)^2);
    a_mat(b1(k),b1(k))=a_mat(b1(k),b1(k))-h(k)*(len1+len2)/3;
    a_mat(b1(k),b2(k))=a_mat(b1(k),b2(k))-h(k)*(len1)/6;
    a_mat(b1(k),b3(k))=a_mat(b1(k),b3(k))-h(k)*(len2)/6;
    b_ray(b1(k))=b_ray(b1(k))-h(k)*ta(k)*(len1+len2)/2;
end
%
u=a_mat\b_ray;
%
figure();
for i=1:size(ele,1)
    if ele(i,6)==8
        if ele(i,4)==ele(i,5)

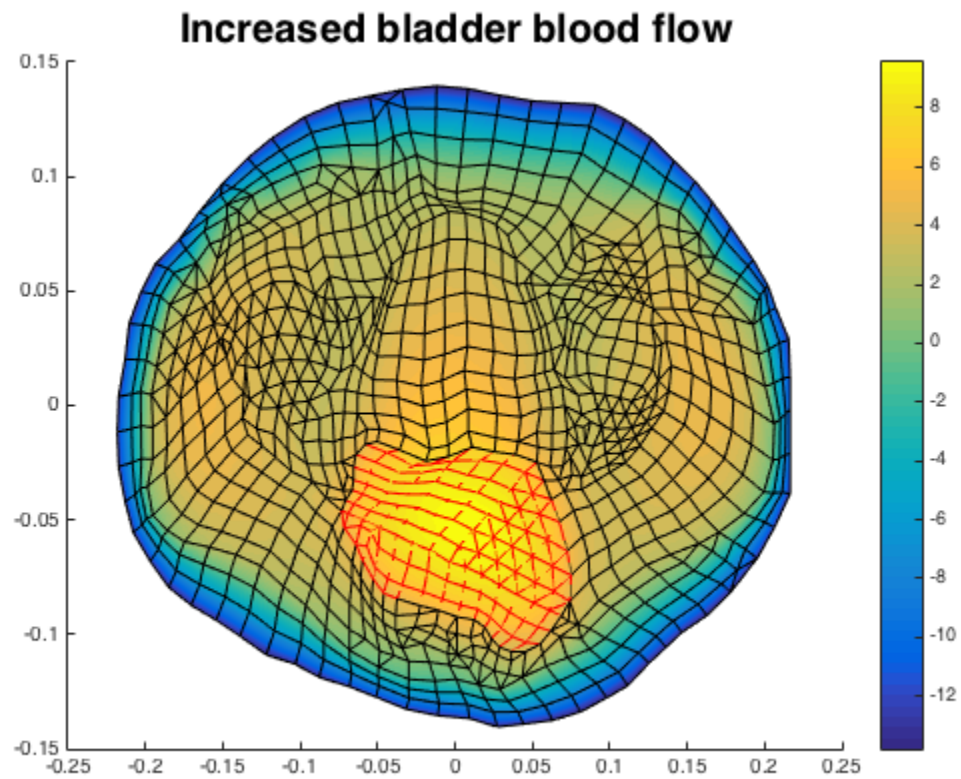
patch(nod(ele(i,2:4),2),nod(ele(i,2:4),3),u(ele(i,2:4)),'FaceColor','interp','EdgeColor','none');
            hold on;
        else

patch(nod(ele(i,2:5),2),nod(ele(i,2:5),3),u(ele(i,2:5)),'FaceColor','interp','EdgeColor','none');
            hold on;
        end
    else
        if ele(i,4)==ele(i,5)

patch(nod(ele(i,2:4),2),nod(ele(i,2:4),3),u(ele(i,2:4)),'FaceColor','interp','EdgeColor','none');
            hold on;
        else

```

```
patch(nod(ele(i,2:5),2),nod(ele(i,2:5),3),u(ele(i,2:5)),'FaceColor','interp');
    hold on;
    end
end
end
title('Increased bladder blood flow','fontsize',20);
colorbar;
```



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