Homework 1

Problem1:

Source code:

Problem1.m

```
c=imread('basketball-court.ppm');
imshow(c);
height=940;
width=500;
output = zeros(height,width,3,'uint8');
% 4 points x
x11 = [1 1];
x12 = [width 1];
x13 = [1 height];
x14 = [width height];
% 4 points x'
x21 = [247 53];
x22 = [403 76];
x23 = [25 194];
x24 = [280 280];

x = [x11; x12; x13; x14];
xt = [x21; x22; x23; x24];
h =dlt(x,xt);%DLT function

%inverse warping and bilinear interpolation
for i=1:height
    for j=1:width
        t = [(h(1,1)*j+h(1,2)*i+h(1,3))/(h(3,1)*j+h(3,2)*i+h(3,3))
(h(2,1)*j+h(2,2)*i+h(2,3))/(h(3,1)*j+h(3,2)*i+h(3,3))];
        a = t(1)-floor(t(1));
        b = t(2)-floor(t(2));
        ft1 =floor(t(1));
        ft2 = floor(t(2));
        output(i,j,:) =
c(ft2,ft1,:)*(1-a)*(1-b)+c(ft2,ft1+1,:)*(a)*(1-b)+c(ft2+1,ft1,:)*b*(1
-a)+c(ft2+1,ft1+1,:)*a*b;
    end
end

figure,imshow(output);
imwrite(output,'problem1.jpg')
```

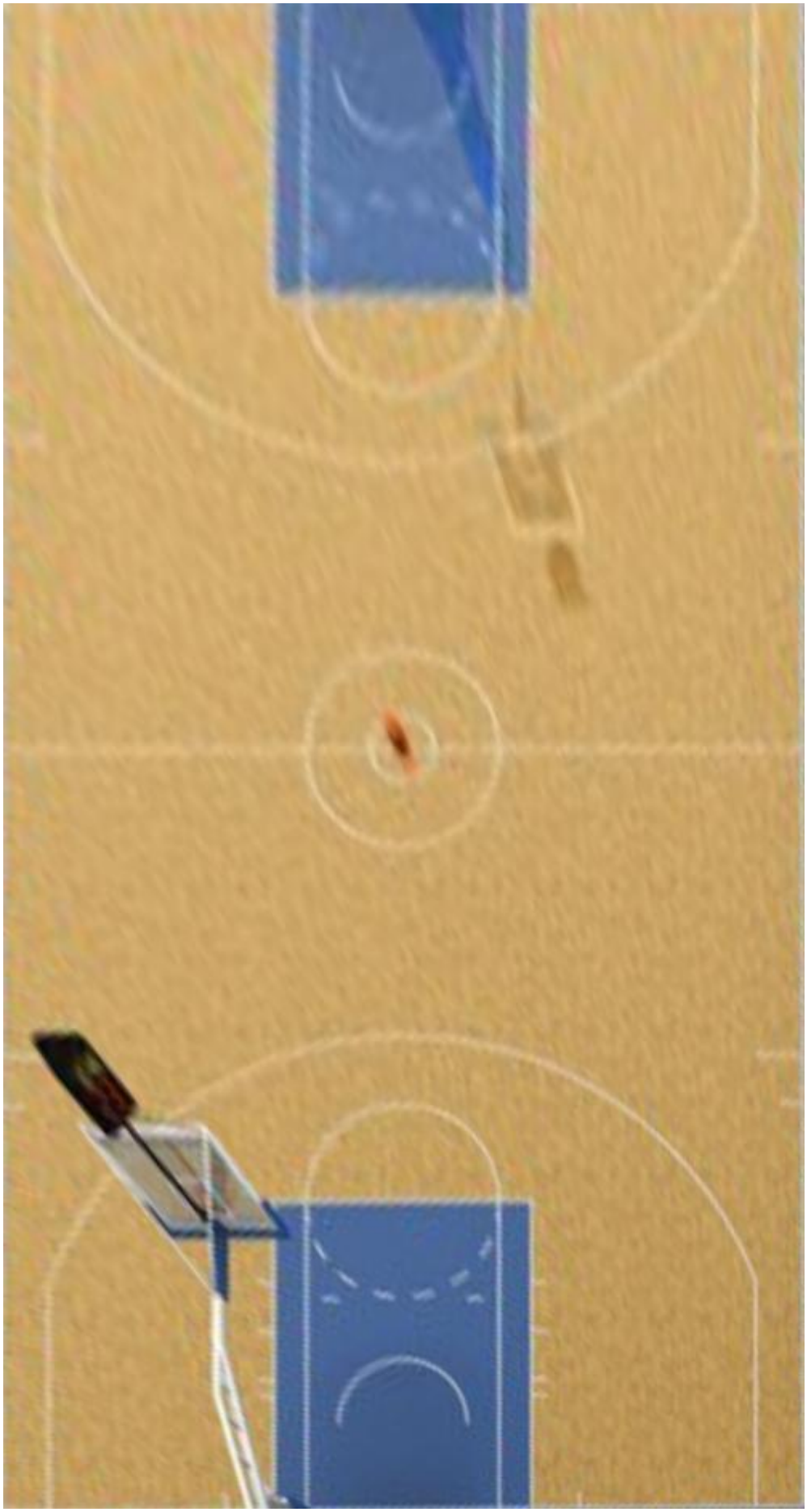
dlt.m

```
function H = dlt( x, xt )
a=[];
for i = 1:4
    a = [a;
        [0 0 0 -x(i,1) -x(i,2) -1 xt(i,2)*x(i,1) xt(i,2)*x(i,2) xt(i,2)];
        [x(i,1) x(i,2) 1 0 0 0 -xt(i,1)*x(i,1) -xt(i,1)*x(i,2) -xt(i,1)]];
end
syms h1 h2 h3 h4 h5 h6 h7 h8 h9
[h1 h2 h3 h4 h5 h6 h7 h8 h9] = solve(a*[h1; h2; h3; h4; h5; h6; h7; h8;
h9],h9-1,'h1', 'h2', 'h3', 'h4', 'h5', 'h6', 'h7', 'h8', 'h9');
H = double([h1 h2 h3;h4 h5 h6; h7 h8 h9]);
```

Points used in the computation:

4 points used to determine the court:
1: (247 53)
2: (403 76)
3: (25 194)
4: (280 280)

Resulting image:



Problem 2:

The artifacts are caused by loss of information due to projection from 3D to 2D. In problem 2, 2 pairs of rectangles are selected to fix the artifacts after DLT.

Source code:

problem2.m

```
c=imread('basketball-court.ppm');
imshow(c);
height=940;
width=500;
output = zeros(height,width,3,'uint8');
% 4 points x
x11 = [1 1];
x12 = [width 1];
x13 = [1 height];
x14 = [width height];
% 4 points x'
x21 = [247 53];
x22 = [403 76];
x23 = [25 194];
x24 = [280 280];

x = [x11; x12; x13; x14];
xt = [x21; x22; x23; x24];
h =dlt(x,xt);%DLT function

%inverse warping and bilinear interpolation
for i=1:height
    for j=1:width
        t = [(h(1,1)*j+h(1,2)*i+h(1,3))/(h(3,1)*j+h(3,2)*i+h(3,3))
(h(2,1)*j+h(2,2)*i+h(2,3))/(h(3,1)*j+h(3,2)*i+h(3,3))];
        a = t(1)-floor(t(1));
        b = t(2)-floor(t(2));
        ft1 =floor(t(1));
        ft2 = floor(t(2));
        output(i,j,:) =
c(ft2,ft1,:)*(1-a)*(1-b)+c(ft2,ft1+1,:)*(a)*(1-b)+c(ft2+1,ft1,:)*b*(1
-a)+c(ft2+1,ft1+1,:)*a*b;
    end
end

%first rectangle
```

```
x11 = [200 540];
x12 = [1 540];
x13 = [200 939];
x14 = [1 939];
%match rectangle
x21 = [300 540];
x22 = [499 540];
x23 = [300 939];
x24 = [499 939];

x = [x11; x12; x13; x14];
xt = [x21; x22; x23; x24];
h =dlt(x,xt);

for i=540:939
    for j=1:200
        t = [(h(1,1)*j+h(1,2)*i+h(1,3))/(h(3,1)*j+h(3,2)*i+h(3,3))
(h(2,1)*j+h(2,2)*i+h(2,3))/(h(3,1)*j+h(3,2)*i+h(3,3))];
        a = t(1)-floor(t(1));
        b = t(2)-floor(t(2));
        ft1 =floor(t(1));
        ft2 = floor(t(2));
        output(i,j,:) =
output(ft2,ft1,:)*(1-a)*(1-b)+output(ft2,ft1+1,:)*(a)*(1-b)+output(ft
2+1,ft1,:)*b*(1-a)+output(ft2+1,ft1+1,:)*a*b;
    end
end
%second rectangle
x11 = [250 1];
x12 = [250 400];
x13 = [500 1];
x14 = [500 400];
%match rectangle
x21 = [250 1];
x22 = [250 400];
x23 = [1 1];
x24 = [1 400];

x = [x11; x12; x13; x14];
xt = [x21; x22; x23; x24];
h =dlt(x,xt);

for i=1:400
    for j=250:500
```

```
        t = [(h(1,1)*j+h(1,2)*i+h(1,3))/(h(3,1)*j+h(3,2)*i+h(3,3))
(h(2,1)*j+h(2,2)*i+h(2,3))/(h(3,1)*j+h(3,2)*i+h(3,3))];
        a = t(1)-floor(t(1));
        b = t(2)-floor(t(2));
        ft1 =floor(t(1));
        ft2 = floor(t(2));
        output(i,j,:) =
output(ft2,ft1,:)*(1-a)*(1-b)+output(ft2,ft1+1,:)*(a)*(1-b)+output(ft
2+1,ft1,:)*b*(1-a)+output(ft2+1,ft1+1,:)*a*b;
    end
end

figure,imshow(output);
imwrite(output,'problem2.jpg')
```

Points used in the computation:

2 pairs of rectangles are selected to fix the problem.

First rectangle:
(200 540) (1 540) (200 939) (1 939)
Match rectangle:
(300 540) (499 540) (300 939) (499 939)

Second rectangle:
(250 1) (250 400) (500 1) (500 400)
Match rectangle:
(250 1) (250 400) (1 1) (1 400)

Resulting image: