CS685 Homework 5

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1. Cube coordinates:

$$X = \begin{bmatrix} 0 & 1.00 & 1.00 & 0.00 & 0.00 & 0.00 & 1.00 & 1.00 \\ 0 & 0.00 & 1.00 & 1.00 & 1.00 & 0.00 & 0.00 & 1.00 \\ 0 & 0.00 & 0.00 & 0.00 & 1.00 & 1.00 & 1.00 & 1.00 \end{bmatrix}$$

Camera Rotation:

$$R = \begin{bmatrix} 0 & 0.00 & -1.00 \\ 1 & 0.00 & 0.00 \\ 0 & -1.00 & 0.00 \end{bmatrix}$$

Camera Translation:

$$T = \begin{bmatrix} 2 \\ 0 \\ 0 \end{bmatrix}$$

Plot:

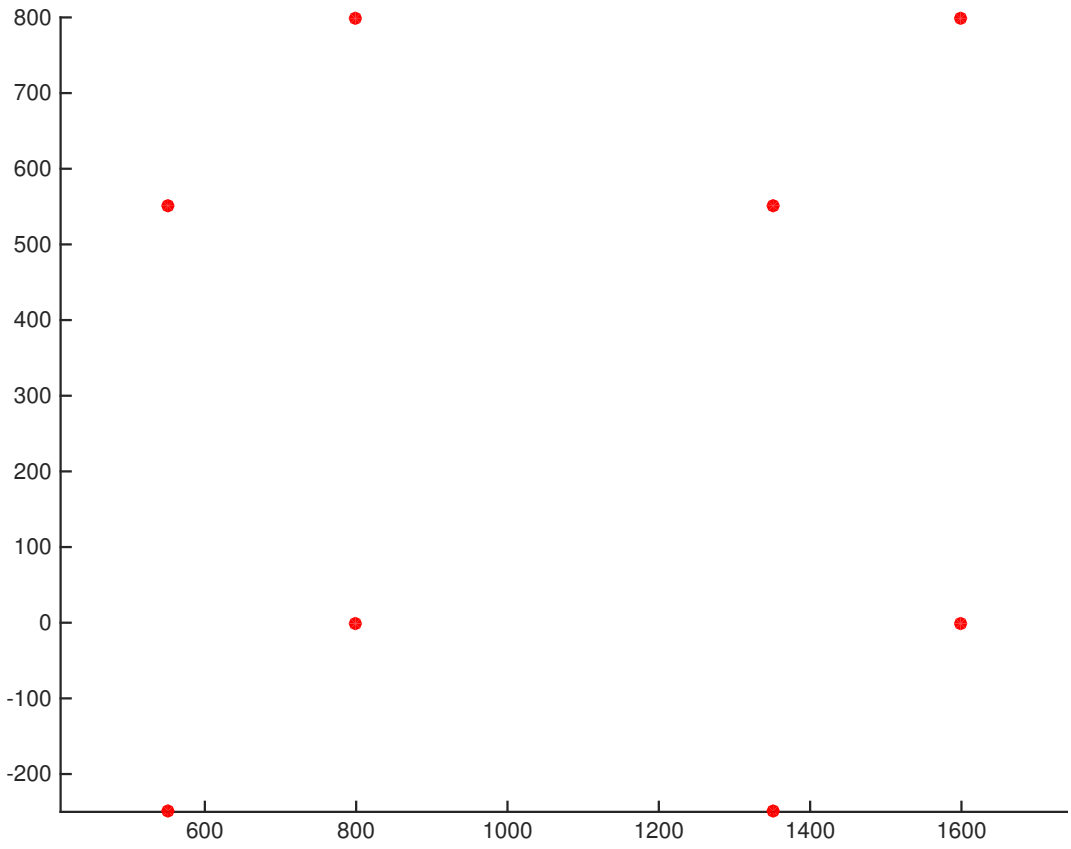

Figure 1: Plot of the vertices of the cube.

2. Results:

$$R = \begin{bmatrix} 0.35877 & -0.41129 & 0.83793 \\ 0.79722 & 0.60194 & -0.045886 \\ -0.48551 & 0.68448 & 0.54385 \end{bmatrix}$$

$$T = \begin{bmatrix} 0.10000 \\ 0.10000 \\ 15.000 \end{bmatrix}$$

$$K = \begin{bmatrix} 0.066224 & 1.3878 \times 10^{-16} & 2.2551 \times 10^{-16} \\ 0.0000 & 0.066224 & 3.4694 \times 10^{-16} \\ 0.0000 & 0.0000 & 0.066224 \end{bmatrix}$$

Code:

```
function [R,T,K] = calibration2Dto3D(X,x)

h = 1;

for k =1:size(x, 2)

A(h, :) = [X(1, k) X(2, k) X(3, k) 1 ...
           0 0 0 0 ...
           -x(1, k)*X(1, k) -x(1, k)*X(2, k) ...
           -x(1, k)*X(3, k) -x(1, k)];
A(h + 1, :) = [0 0 0 0 ...
               X(1, k) X(2, k) X(3, k) 1 ...
               -x(2, k)*X(1, k) -x(2, k)*X(2, k) ...
               -x(2, k)*X(3, k) -x(2, k)];
h = h + 2;
end;

[U S V] = svd(A);

% camera matrix
P = V(:, size(V,2));
P = reshape(P, 4, 3)';

[K,R] = rq(P(:,1:3));

% make diagonal of K positive
S = diag(sign(diag(K)));

K = K * S;
R = S * R;

T = inv(K)*P(:,4);

end
```

```
% rq decomposition
function [R Q] = rq(M)
    [Q,R] = qr(flipud(M)');
    R = flipud(R');
    R = fliplr(R);

    Q = Q';
    Q = flipud(Q);
end
```