HW5

5-1

HW5_1.m

```matlab
data = xlsread('HW5-1.xls');
A = ones(50,3);
for i = 1:50
    A(i,1) = data(i,1);
    A(i,2) = data(i,2);
end
Y = data(:,3);
x = (((A.') * A) \ (A.')) * Y;
%.' transpose
%\ inverse. And it's better than inv()
disp(x);
```

Command Window

```
>> HW5_1
    0.2000
    0.3000
   -0.0000
```

5-2

$$ {}^{S}_{E}\hat{\boldsymbol{q}} = \begin{bmatrix} q_1 & q_2 & q_3 & q_4 \end{bmatrix} $$

$$ {}^{E}\hat{\boldsymbol{d}} = \begin{bmatrix} 0 & d_x & d_y & d_z \end{bmatrix} = [0\ 0\ 0\ \text{-}9.8] $$

→

$$ \boldsymbol{f}({}^{S}_{E}\hat{\boldsymbol{q}}_k, {}^{E}\hat{\boldsymbol{d}}, {}^{S}\hat{\boldsymbol{s}}) = \begin{bmatrix} 2d_x(\frac{1}{2} - q_3^2 - q_4^2) + 2d_y(q_1q_4 + q_2q_3) + 2d_z(q_2q_4 - q_1q_3) - s_x \\ 2d_x(q_2q_3 - q_1q_4) + 2d_y(\frac{1}{2} - q_2^2 - q_4^2) + 2d_z(q_1q_2 + q_3q_4) - s_y \\ 2d_x(q_1q_3 + q_2q_4) + 2d_y(q_3q_4 - q_1q_2) + 2d_z(\frac{1}{2} - q_2^2 - q_3^2) - s_z \end{bmatrix} $$

$$ \boldsymbol{J}({}^{S}_{E}\hat{\boldsymbol{q}}_k, {}^{E}\hat{\boldsymbol{d}}) = \begin{bmatrix} 2d_yq_4 - 2d_zq_3 & 2d_yq_3 + 2d_zq_4 & -4d_xq_3 + 2d_yq_2 - 2d_zq_1 & -4d_xq_4 + 2d_yq_1 + 2d_zq_2 \\ -2d_xq_4 + 2d_zq_2 & 2d_xq_3 - 4d_yq_2 + 2d_zq_1 & 2d_xq_2 + 2d_zq_4 & -2d_xq_1 - 4d_yq_4 + 2d_zq_3 \\ 2d_xq_3 - 2d_yq_2 & 2d_xq_4 - 2d_yq_1 - 4d_zq_2 & 2d_xq_1 + 2d_yq_4 - 4d_zq_3 & 2d_xq_2 + 2d_yq_3 \end{bmatrix} $$

$$ \nabla \boldsymbol{f}({}^{S}_{E}\hat{\boldsymbol{q}}_k, {}^{E}\hat{\boldsymbol{d}}, {}^{S}\hat{\boldsymbol{s}}) = \boldsymbol{J}^T({}^{S}_{E}\hat{\boldsymbol{q}}_k, {}^{E}\hat{\boldsymbol{d}})\boldsymbol{f}({}^{S}_{E}\hat{\boldsymbol{q}}_k, {}^{E}\hat{\boldsymbol{d}}, {}^{S}\hat{\boldsymbol{s}}) $$

→

$$ {}^{S}_{E}\boldsymbol{q}_{k+1} = {}^{S}_{E}\hat{\boldsymbol{q}}_k - \mu \frac{\nabla \boldsymbol{f}({}^{S}_{E}\hat{\boldsymbol{q}}_k, {}^{E}\hat{\boldsymbol{d}}, {}^{S}\hat{\boldsymbol{s}})}{\left\| \nabla \boldsymbol{f}({}^{S}_{E}\hat{\boldsymbol{q}}_k, {}^{E}\hat{\boldsymbol{d}}, {}^{S}\hat{\boldsymbol{s}}) \right\|}, \ k = 0, 1, 2 \ldots n $$