Homework 6, Problem 3

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```
clear
addpath /Users/davidlim/Documents/ModernRobotics/packages/
MATLAB/mr;
```

Dimensional parameters:

```
W1 = 0.109;
W2 = 0.082;
L1 = 0.425;
L2 = 0.392;
H1 = 0.089;
H2 = 0.095;
```

End-effector zero position:

```
M = [-1 0 0 L1+L2; ...
     0 0 1 W1+W2; ...
     0 1 0 H1-H2; ...
     0 0 0 1];
```

Scew axes in space frame:

```
S1 = [0 0 1 0 0 0]';
S2 = [0 1 0 -H1 0 0]';
S3 = [0 1 0 -H1 0 L1]';
S4 = [0 1 0 -H1 0 L1+L2]';
S5 = [0 0 -1 -W1 L1+L2 0]';
S6 = [0 1 0 H2-H1 0 L1+L2]';
```

Screw axes in body frame:

```
Adj = Adjoint(TransInv(M));
B1 = Adj*S1;
B2 = Adj*S2;
B3 = Adj*S3;
```

```
B4 = Adj*S4;
B5 = Adj*S5;
B6 = Adj*S6;
Blist = [B1,B2,B3,B4,B5,B6];
```

Desired end-effector position:

```
Tsd = [0 1 0 -0.5; ...
       0 0 -1 0.1; ...
       -1 0 0 0.1; ...
       0 0 0 1];
```

Error limits:

```
epsw = 0.001;
epsv = 0.001;
```

Initial guess for joint angles:

```
thetalist0 = [2.6; -0.9; 1.8; 0; 0; 0];
```

IK program and iteration reports:

```
[thetalist, ~] = IKinBodyIterations(Blist, M, Tsd, thetalist0,
epsw, epsv)
```

```
Iteration: 0
Joint vector:
    2.6000   -0.9000    1.8000         0         0         0
End-effector configuration:
    0.5327   -0.6712   -0.5155   -0.4699
   -0.3204    0.4038   -0.8569    0.0598
    0.7833    0.6216         0    0.0558
         0         0         0    1.0000
Error twist:
   -0.2317    0.6648   -2.3948   -0.0698    0.0411   -0.0180
Angular error magnitude: 2.4961
Linear error magnitude: 0.0829

Iteration: 1
Joint vector:
    2.3638   -0.9228    1.8026   -1.2189   -0.8117   -1.1557
End-effector configuration:
    0.1749    0.9846    0.0044   -0.4594
    0.2384   -0.0380   -0.9704    0.2203
   -0.9553    0.1708   -0.2413    0.0164
         0         0         0    1.0000
Error twist:
```

```
   -0.0171   -0.2435   -0.1755   -0.1012   -0.0317    0.1097
Angular error magnitude: 0.3006
Linear error magnitude: 0.1525

Iteration: 2
Joint vector:
    2.5891   -1.0339    1.8149   -0.8746   -0.5165   -1.4458
End-effector configuration:
    0.0453    0.9983   -0.0377   -0.4899
    0.0445   -0.0398   -0.9982    0.0902
   -0.9980    0.0435   -0.0462    0.0799
         0         0         0    1.0000
Error twist:
   -0.0388   -0.0454   -0.0444   -0.0201   -0.0099   -0.0101
Angular error magnitude: 0.0744
Linear error magnitude: 0.0246

Iteration: 3
Joint vector:
    2.5865   -1.0187    1.7261   -0.6997   -0.5520   -1.5784
End-effector configuration:
   -0.0011    1.0000   -0.0031   -0.4997
   -0.0040   -0.0031   -1.0000    0.0995
   -1.0000   -0.0011    0.0041    0.1014
         0         0         0    1.0000
Error twist:
   -0.0031    0.0040    0.0011    0.0014   -0.0003   -0.0005
Angular error magnitude: 0.0052
Linear error magnitude: 0.0016

Iteration: 4
Joint vector:
    2.5862   -1.0171    1.7269   -0.7099   -0.5554   -1.5708
End-effector configuration:
    0.0000    1.0000   -0.0000   -0.5000
    0.0000   -0.0000   -1.0000    0.1000
   -1.0000    0.0000   -0.0000    0.1000
         0         0         0    1.0000
Error twist:
   1.0e-04 *
   -0.1557   -0.2386   -0.0743    0.0045   -0.0005   -0.0183
Angular error magnitude: 0.0000
Linear error magnitude: 0.0000

thetalist = 6×1
    2.5862
   -1.0171
    1.7269
   -0.7099
   -0.5554
   -1.5708
```

Contents of .csv file:

```
readmatrix('IKiterations.csv')
```

```
ans = 5×6
    2.6000   -0.9000    1.8000         0         0         0
    2.3638   -0.9228    1.8026   -1.2189   -0.8117   -1.1557
    2.5891   -1.0339    1.8149   -0.8746   -0.5165   -1.4458
    2.5865   -1.0187    1.7261   -0.6997   -0.5520   -1.5784
    2.5862   -1.0171    1.7269   -0.7099   -0.5554   -1.5708
```