```
T0 = eye(4,4)
```

T0 = 4×4
```
     1      0      0      0
     0      1      0      0
     0      0      1      0
     0      0      0      1
```
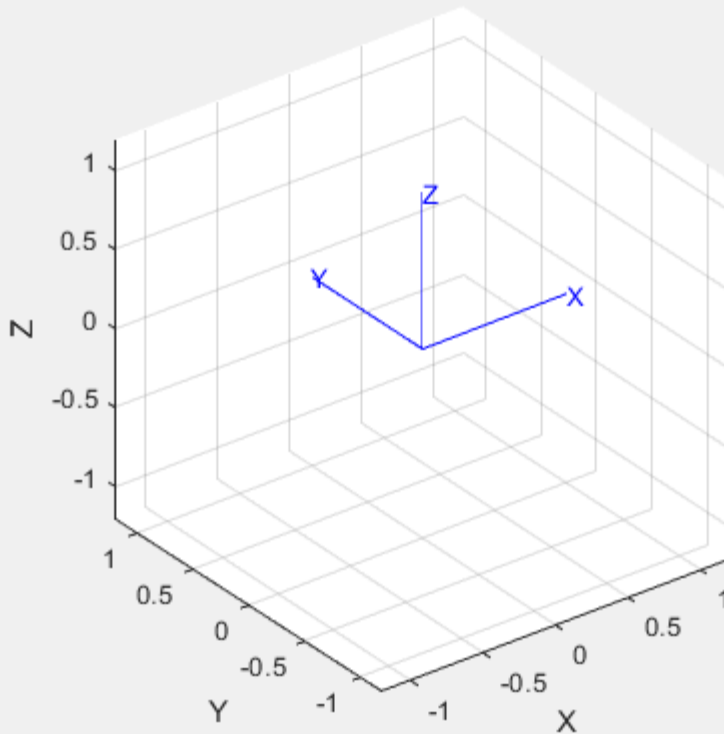
```
T1 = transl(1,2,3)*rpy2tr(0.6, 0.8, 1.4, 'xyz')
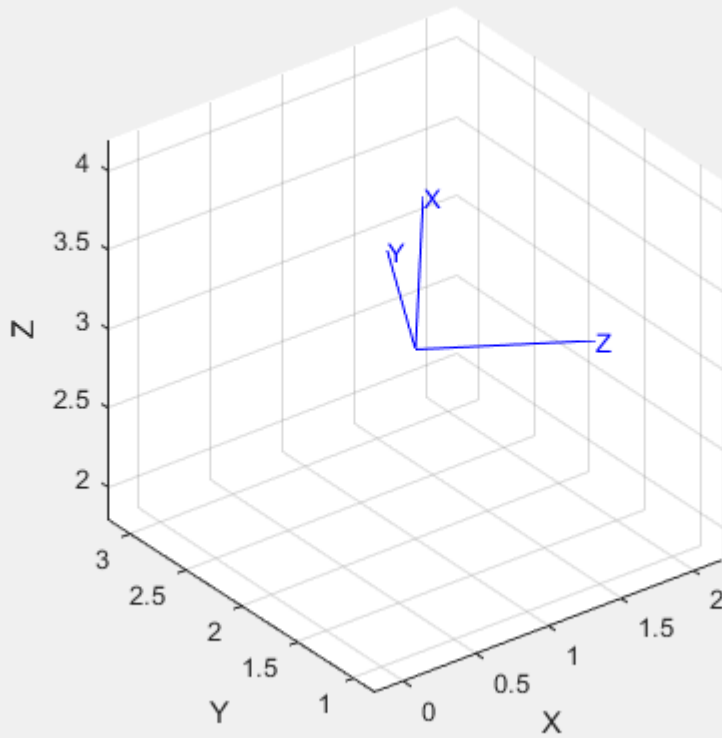```

T1 = 4×4
```
    0.5750   -0.3934   0.7174   1.0000
    0.6794   -0.2589   -0.6866   2.0000
    0.4558   0.8822   0.1184   3.0000
         0   0   0   1.0000
```

```
% the default corresponds to rotations about the Z, Y, X axes
% respectively
```
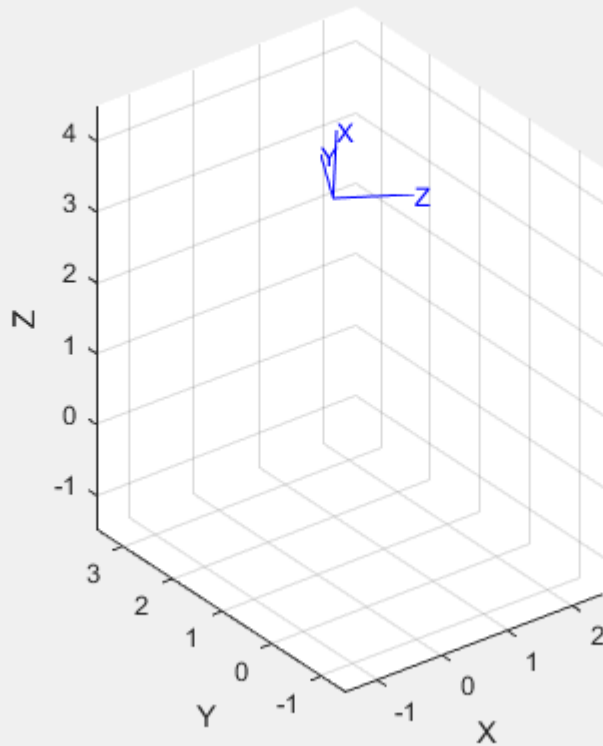
```
trplot(T0)
```



```
trplot(T1)
```

```
tranimate(T0,T1)
```


2

```
tpoly(0, 1, 50) %initial s, final s, time steps (graph)
```
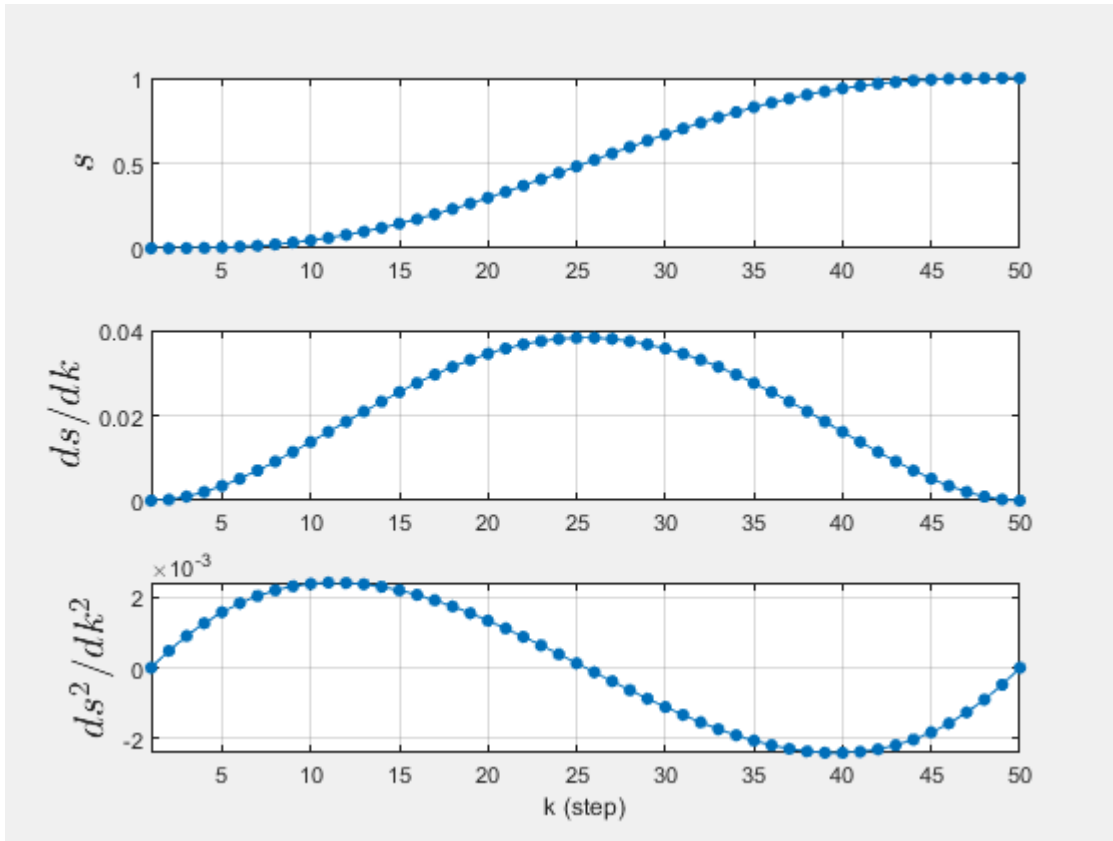


```
s = tpoly(0, 1, 50) %vector s
```

```
s = 50×1
         0
    0.0001
    0.0006
    0.0021
    0.0048
    0.0091
    0.0152
    0.0233
    0.0336
    0.0461
      .
      .
      .
```

```
[s, sd, sdd] = tpoly(0, 1, 50) %vectors s, sd, sdd
```

```
s = 50×1
         0
    0.0001
    0.0006
    0.0021
    0.0048
    0.0091
    0.0152
    0.0233
    0.0336
```

```
        0.0461
          .
          .
          .
 sd = 50×1
             0
        0.0002
        0.0009
        0.0020
        0.0034
        0.0051
        0.0071
        0.0092
        0.0114
        0.0138
          .
          .
          .
sdd = 50×1
             0
        0.0005
        0.0009
        0.0013
        0.0016
        0.0018
        0.0020
        0.0022
        0.0023
        0.0024
          .
          .
          .
```
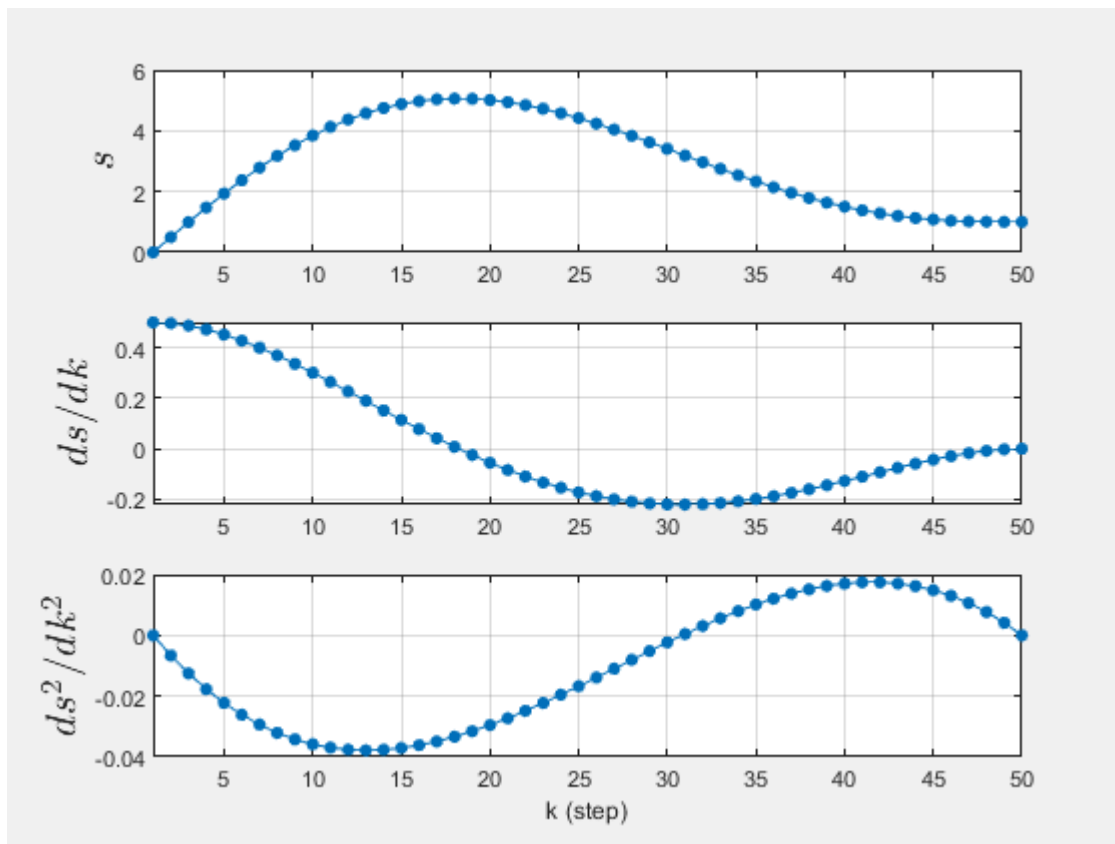
```matlab
tpoly(0, 1, 50, 0.5, 0) %initial s, final s, time steps, initial v, final v
```

```
lspb(0, 1, 50)
```

```
s = lspb(0, 1, 50)
```
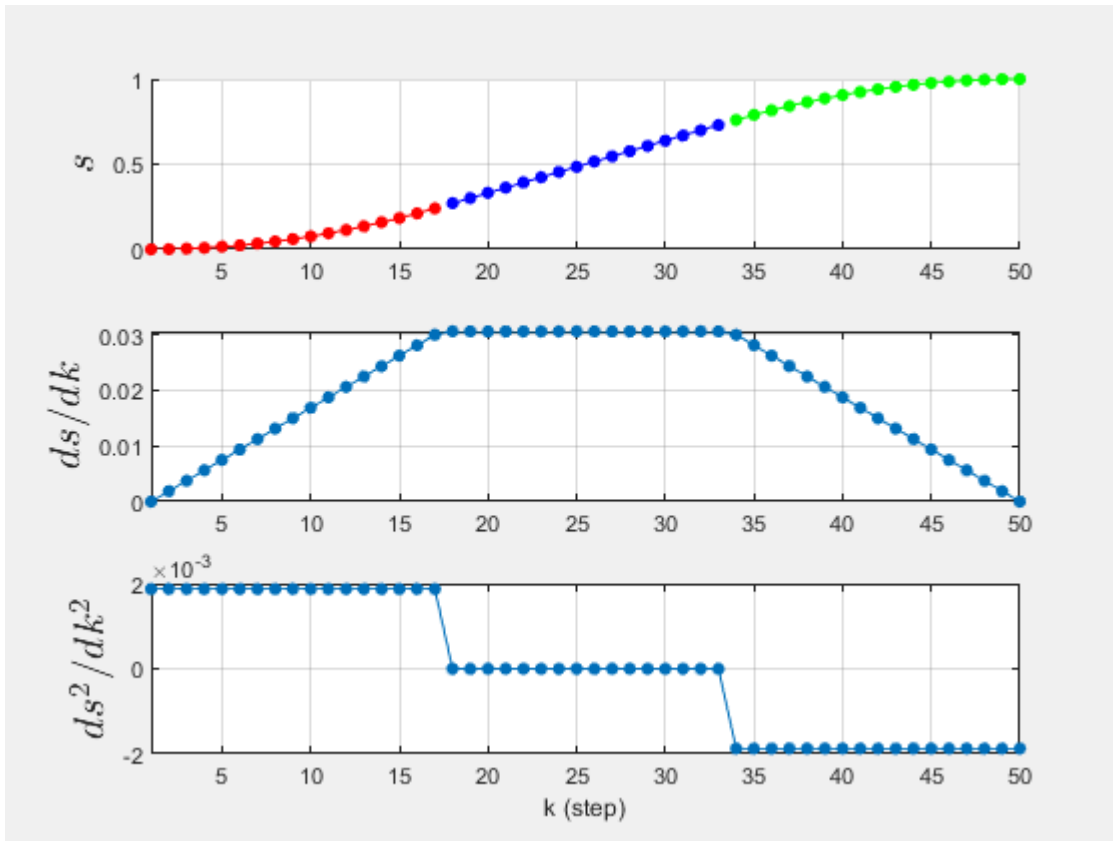
```
s = 50×1
         0
    0.0009
    0.0037
    0.0084
    0.0150
    0.0234
    0.0337
    0.0459
    0.0600
    0.0759
      .
      .
      .
```

```
[s, sd, sdd] = lspb(0, 1, 50)
```

```
s = 50×1
         0
    0.0009
    0.0037
    0.0084
    0.0150
    0.0234
    0.0337
    0.0459
    0.0600
    0.0759
      .
      .
      .

sd = 50×1
```

```
         0
    0.0019
    0.0037
    0.0056
    0.0075
    0.0094
    0.0112
    0.0131
    0.0150
    0.0169
      ⋮
      ⋮
sdd = 50×1
    0.0019
    0.0019
    0.0019
    0.0019
    0.0019
    0.0019
    0.0019
    0.0019
    0.0019
    0.0019
      ⋮
      ⋮
```

```
lspb(0, 1, 50, 0.025)
```
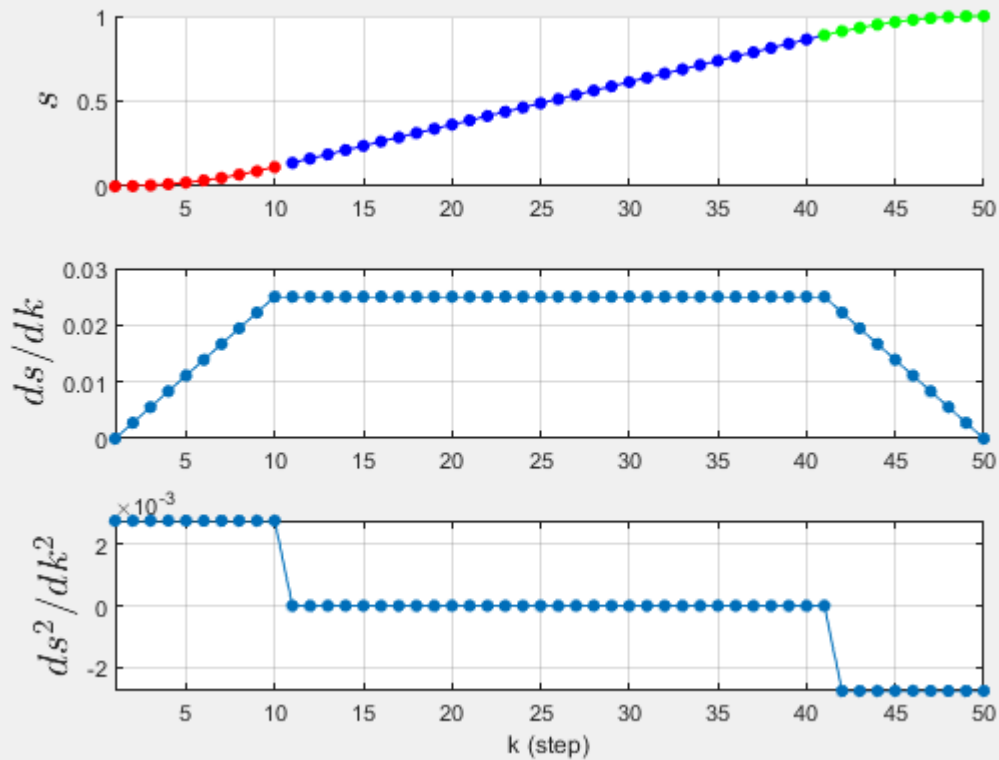


```
lspb(0, 1, 50, 0.035)
```
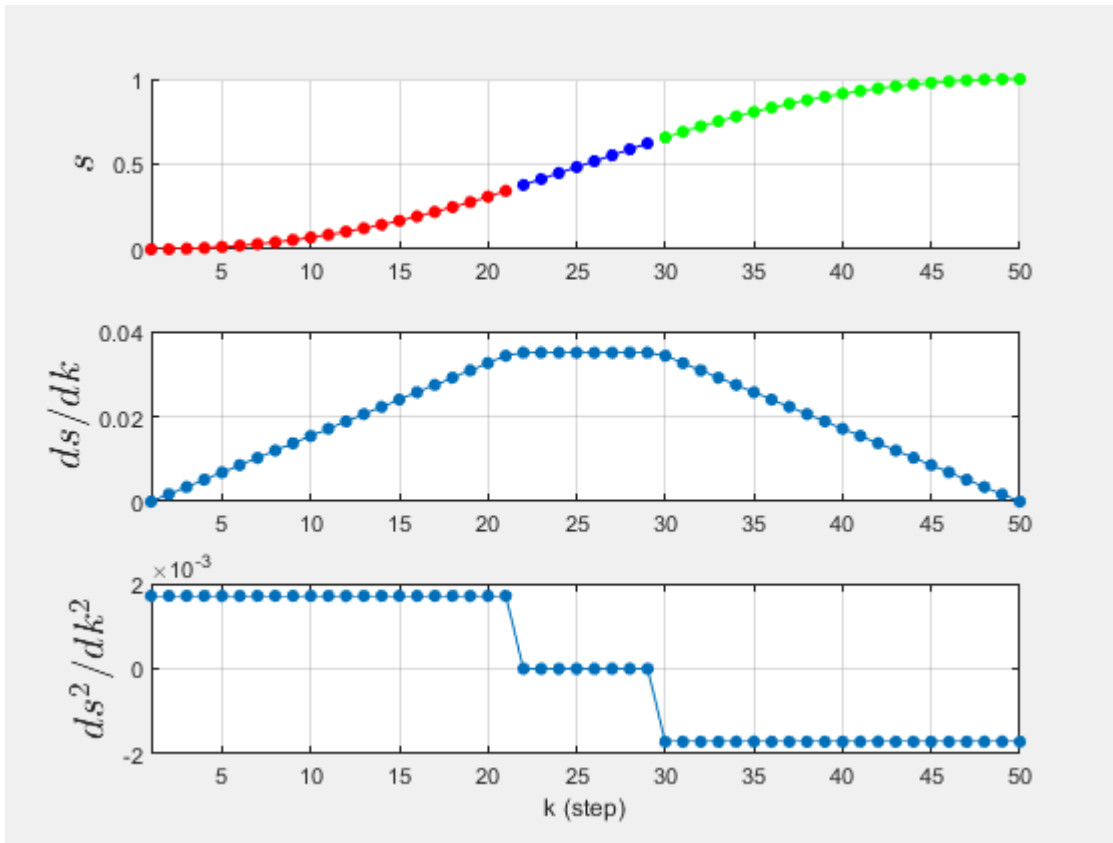
```
mstraj([40;10;30], 1, [], 10, 0.1, 2)
```
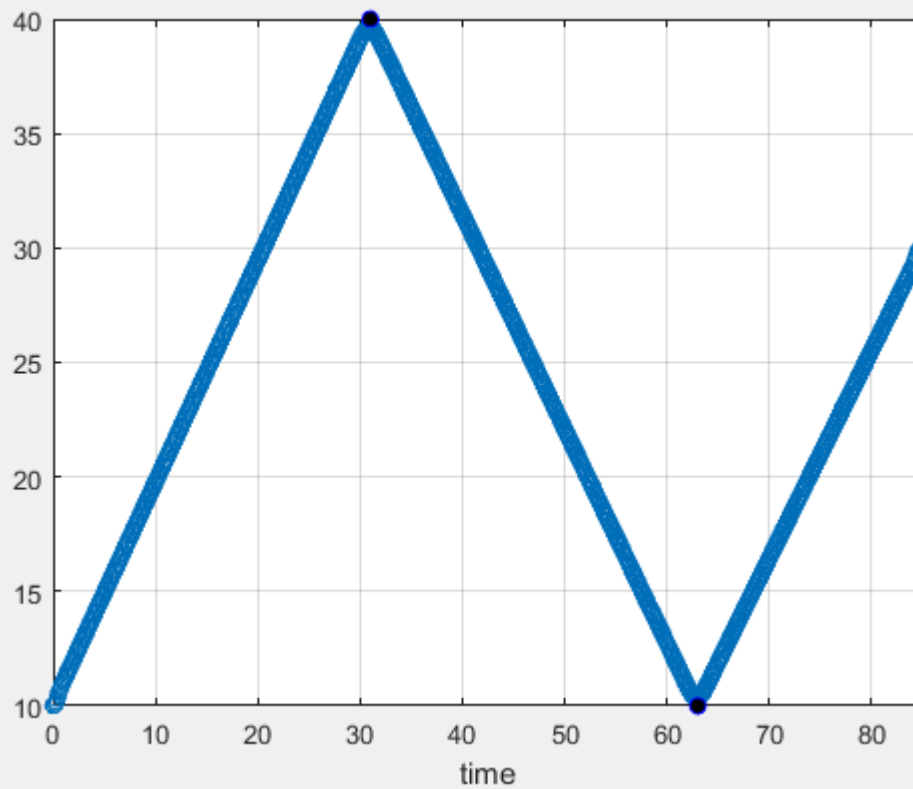
```
% first point: 10,  last point: 30
% via points: 40,10
% velocity is 1 unit per sec
% time interval = 0.1
% t_acc (acceleration time) = 2
```

```
mstraj([40;10;30], 1, [], 10, 0.1, 8)
```
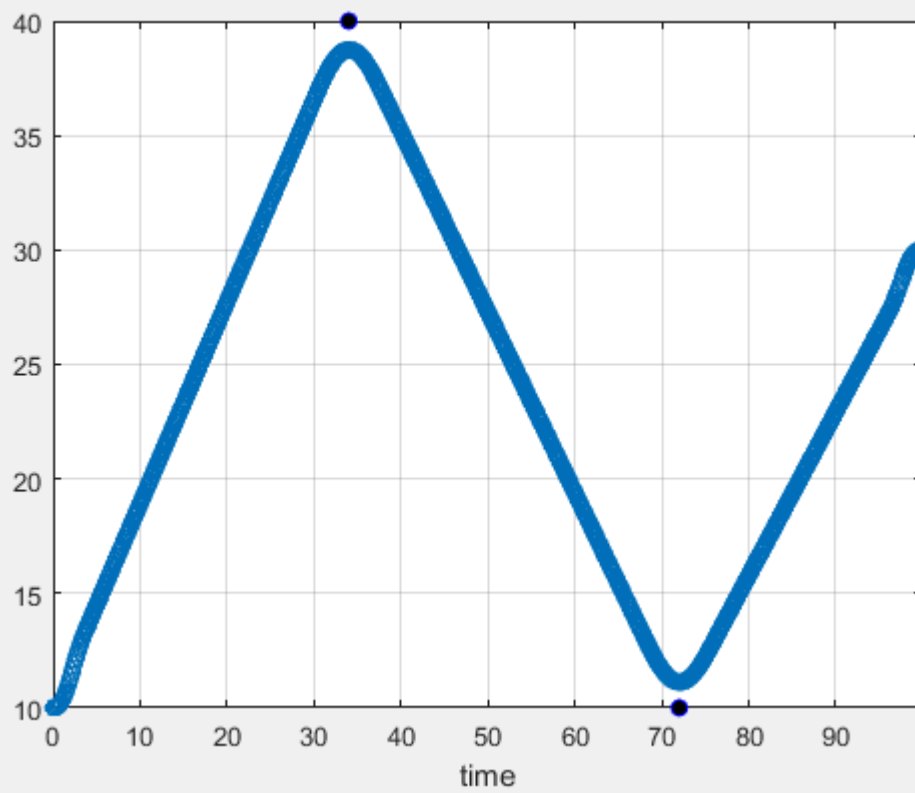
```
% smooth but misses the point
```

```
mstraj([40;10;30], 2, [], 10, 0.1, 4)
```
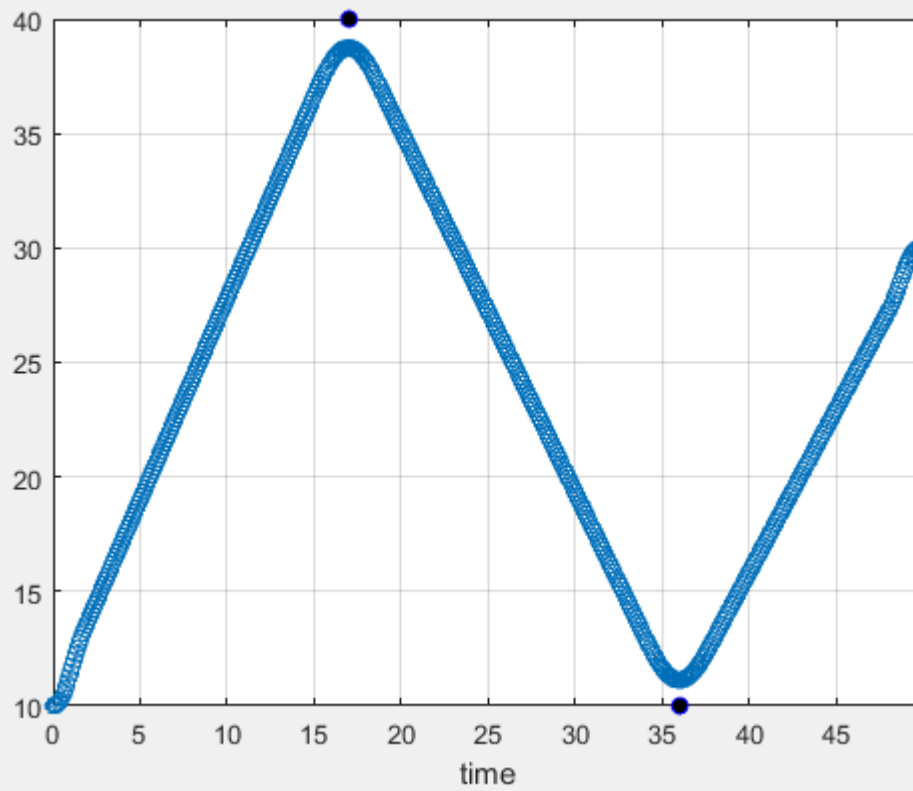
```
% double the speed
```

```
mstraj([40;10;30], [], [10 30 20], 10, 0.1, 4)
```
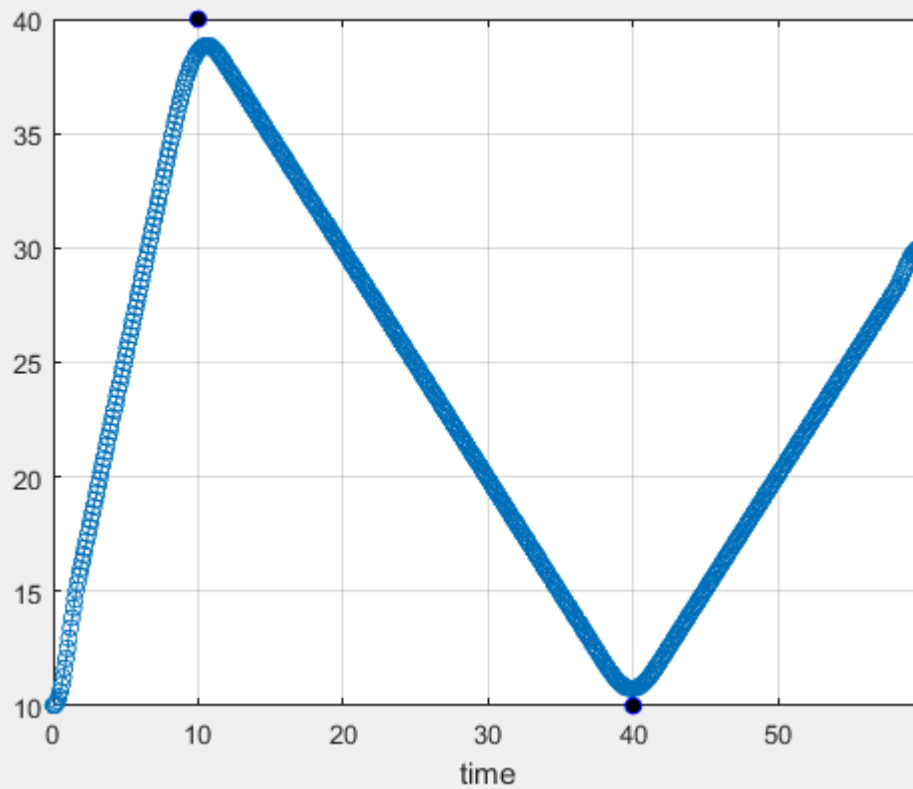
```
% first segment lasts for 10 seconds
% second segment lasts for 30 seconds
% third segment lasts for 20 seconds
```

```
first = [10 20]
```

```
first = 1×2
    10    20
```

```
last = [30 10]
```

```
last = 1×2
    30    10
```

```
x = jtraj(first, last, 50)
```

```
x = 50×2
   10.0000   20.0000
   10.0016   19.9992
   10.0128   19.9936
   10.0418   19.9791
   10.0959   19.9520
   10.1813   19.9094
   10.3031   19.8485
   10.4653   19.7674
   10.6712   19.6644
   10.9229   19.5385
```

```
    ⋮
```

```
% [10 20] is the first point
% [30 10] is the last point
plot(x)
```
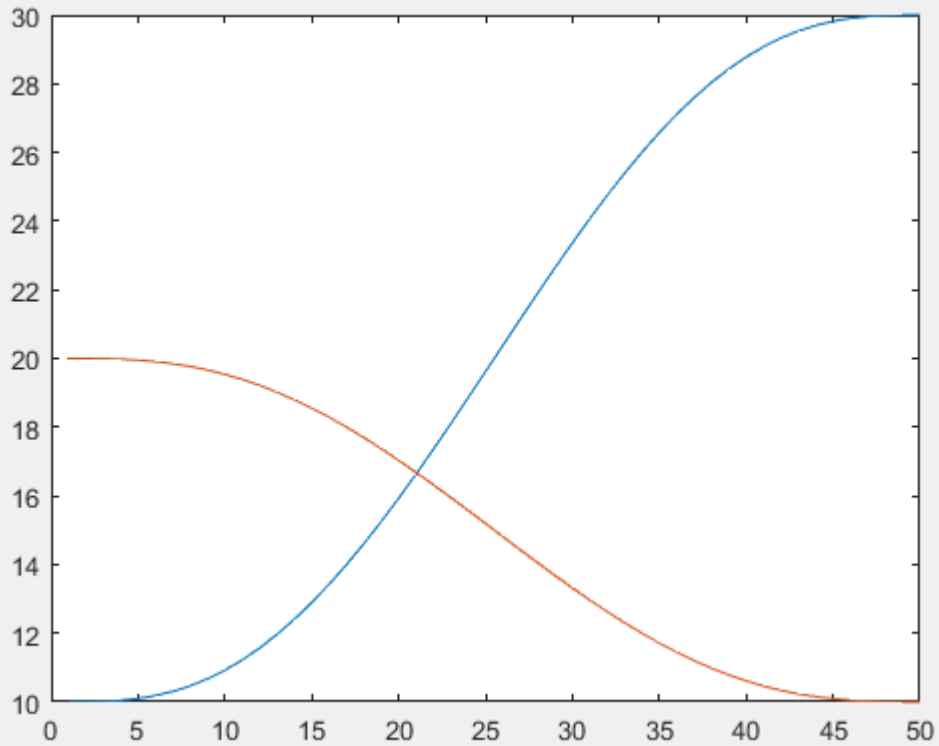


```
[x, xd] = jtraj(first, last, 50)
```

```
x = 50×2
   10.0000   20.0000
   10.0016   19.9992
   10.0128   19.9936
   10.0418   19.9791
   10.0959   19.9520
   10.1813   19.9094
   10.3031   19.8485
   10.4653   19.7674
   10.6712   19.6644
   10.9229   19.5385
     ⋮

xd = 50×2
        0         0
   0.2398   -0.1199
   0.9197   -0.4598
   1.9821   -0.9910
   3.3722   -1.6861
   5.0375   -2.5187
   6.9280   -3.4640
   8.9963   -4.4981
   11.1973  -5.5987
```

```
        13.4888    -6.7444
            ⋮
```

```
plot(xd)
```
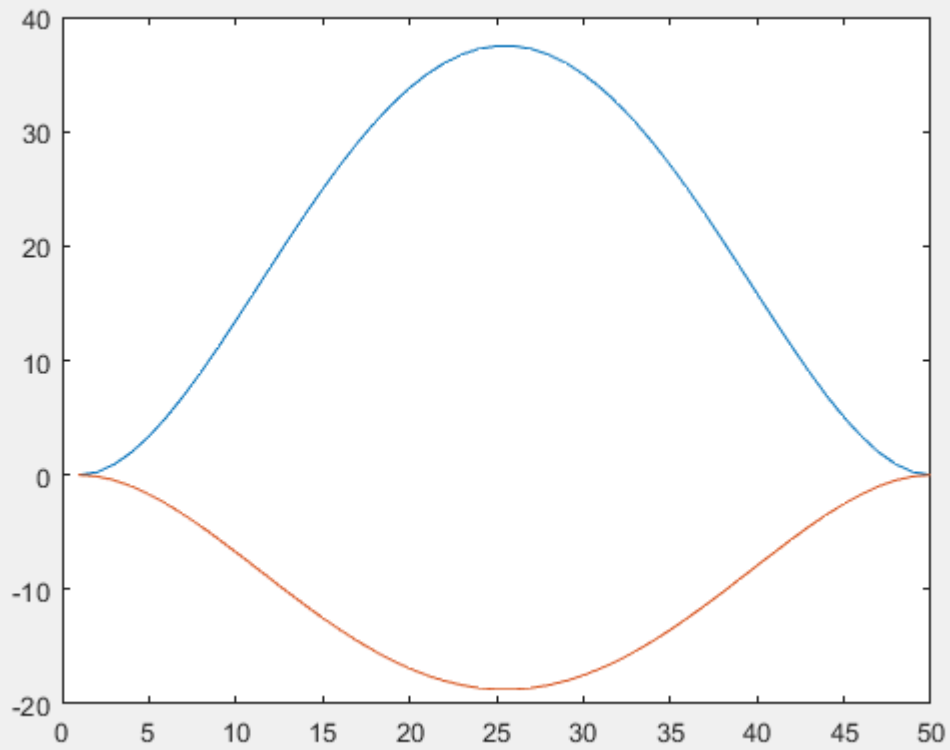


```
v_initial = [0 0]
```

```
v_initial = 1×2
     0     0
```

```
v_final = [10 10]
```

```
v_final = 1×2
    10    10
```

```
[x, xd] = jtraj(first, last, 50, v_initial, v_final)
```

```
x = 50×2
    10.0000    20.0000
    10.0013    19.9988
    10.0103    19.9911
    10.0336    19.9709
    10.0772    19.9333
    10.1461    19.8741
    10.2445    19.7899
    10.3760    19.6781
    10.5433    19.5366
    10.7485    19.3641
        ⋮
        ⋮
```

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```
xd = 50×2
        0         0
   0.1922   -0.1675
   0.7384   -0.6411
   1.5944   -1.3787
   2.7182   -2.3401
   4.0692   -3.4870
   5.6091   -4.7829
   7.3011   -6.1933
   9.1106   -7.6854
  11.0047   -9.2284
      .
      .
      .
```

```
plot(xd)
```
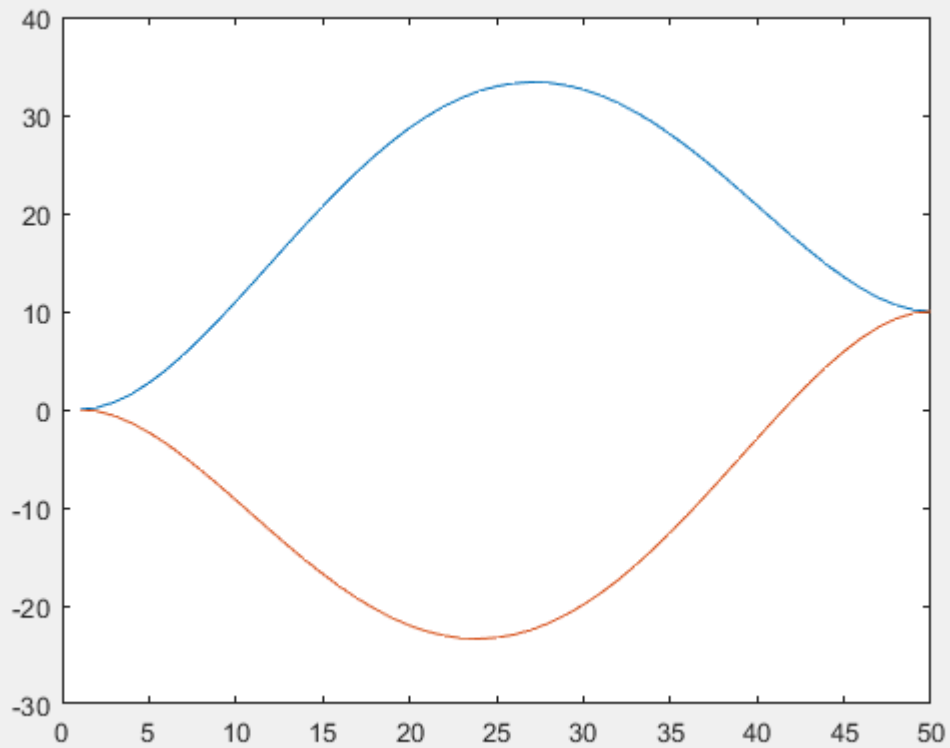


```
% 3d example
start = [40 50]
```

```
start = 1×2
    40    50
```

```
via = [60 30; 40 10; 20 30; start]
```

```
via = 4×2
    60    30
    40    10
    20    30
    40    50
```

```
x = mstraj(via, 2, [], start, 0.1, 1)
```

```
x = 435×2
    40.0344   49.9656
    40.1999   49.8001
    40.4690   49.5310
    40.7412   49.2588
    40.9524   49.0476
    41.1429   48.8571
    41.3333   48.6667
    41.5238   48.4762
    41.7143   48.2857
    41.9048   48.0952
       :
       :
```

```
plot(x) %plot traj vs time
```
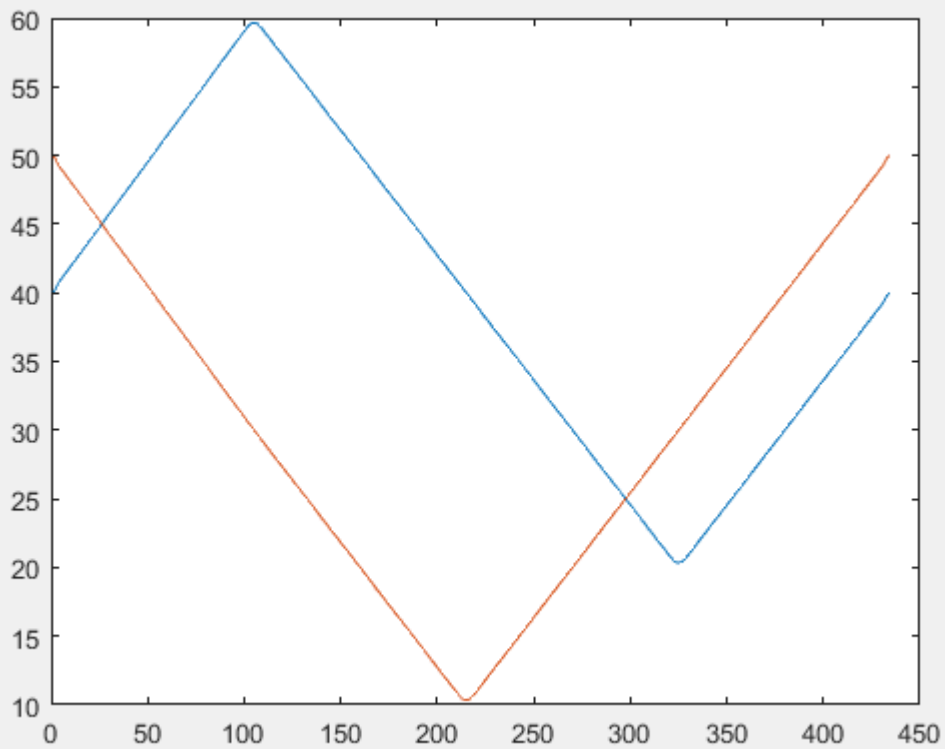


```
plot(x(:,1), x(:,2)) %plot p1 vs p2
```

```matlab
v_x = 1 %v in x axis
```

```
v_x = 1
```

```matlab
v_y = 3 %v in y axis
```

```
v_y = 3
```
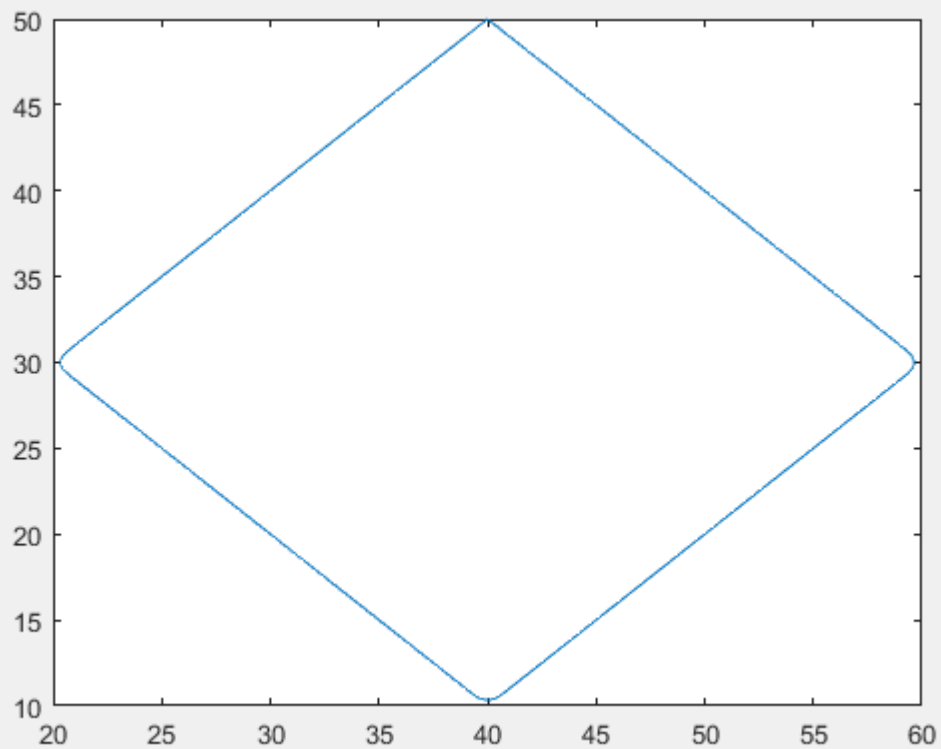
```matlab
x = mstraj(via, [v_x v_y], [], start, 0.1, 1)
```

```
x = 835×2
    40.0176    49.9824
    40.1024    49.8976
    40.2402    49.7598
    40.3796    49.6204
    40.4878    49.5122
    40.5854    49.4146
    40.6829    49.3171
    40.7805    49.2195
    40.8780    49.1220
    40.9756    49.0244
       .
       .
       .
```

```matlab
plot(x)
```
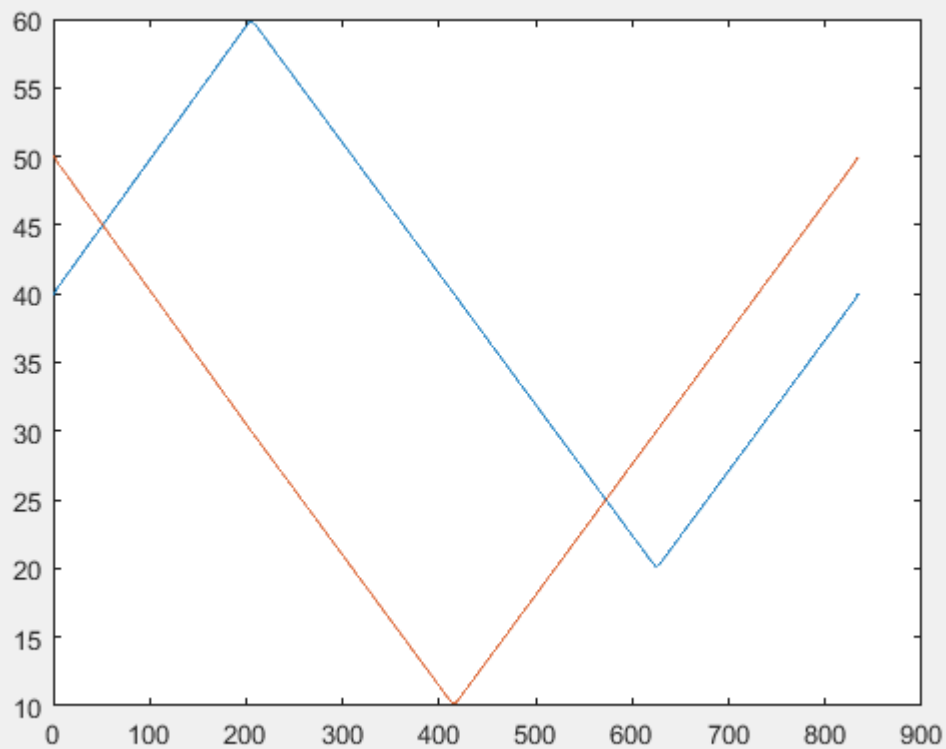
```
%takes twice as long because slowest axis (x axis)
% is half the speed
```

```
rpy_initial = [0 0 0]
```

```
rpy_initial = 1×3
     0     0     0
```

```
rpy_final = [-pi/2 pi/2 pi/4]
```

```
rpy_final = 1×3
   -1.5708    1.5708    0.7854
```

```
x = jtraj(rpy_initial, rpy_final, 100) %100 time steps
```

```
x = 100×3
        0         0         0
  -0.0000    0.0000    0.0000
  -0.0001    0.0001    0.0001
  -0.0004    0.0004    0.0002
  -0.0010    0.0010    0.0005
  -0.0019    0.0019    0.0009
  -0.0032    0.0032    0.0016
  -0.0050    0.0050    0.0025
  -0.0073    0.0073    0.0037
  -0.0103    0.0103    0.0051
     :         :         :
     :         :         :
```

```
plot(x)
```
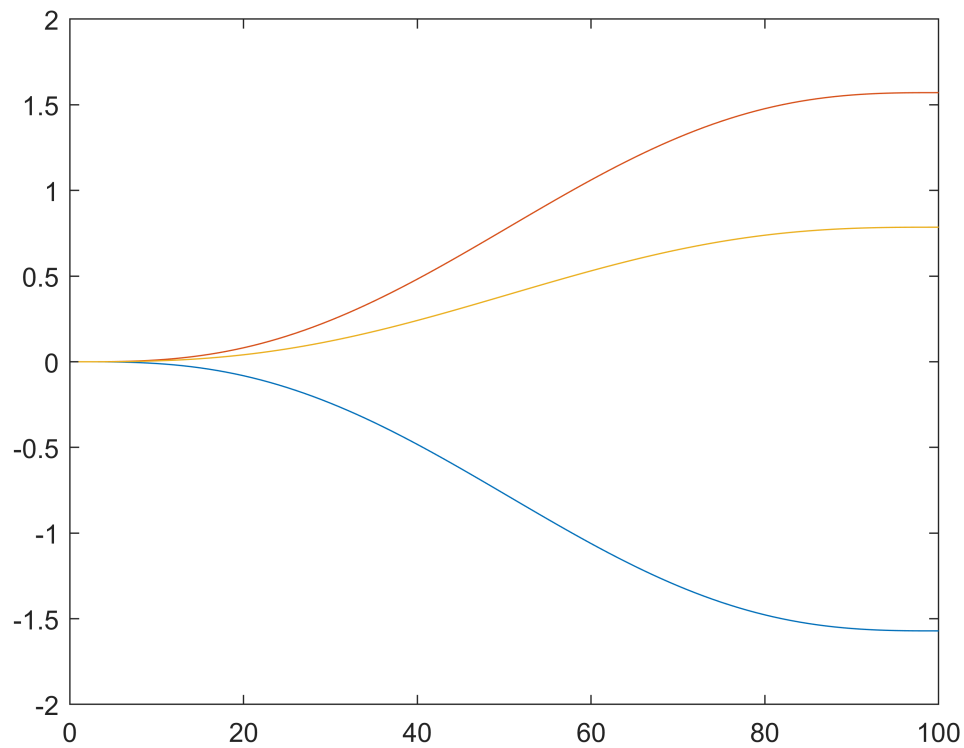


```
R = rpy2r(x, 'xyz') %convert each row into rotation matrix
```

```
R =
R(:,:,1) =

     1     0     0
     0     1     0
     0     0     1


R(:,:,2) =

    1.0000    0.0000    0.0000
   -0.0000    1.0000   -0.0000
   -0.0000    0.0000    1.0000


R(:,:,3) =

    1.0000    0.0001    0.0001
   -0.0001    1.0000   -0.0001
   -0.0001    0.0001    1.0000


R(:,:,4) =

    1.0000    0.0004    0.0004
   -0.0004    1.0000   -0.0002
   -0.0004    0.0002    1.0000
```

```
R(:,:,5) =

    1.0000    0.0010    0.0010
   -0.0010    1.0000   -0.0005
   -0.0010    0.0005    1.0000


R(:,:,6) =

    1.0000    0.0019    0.0019
   -0.0019    1.0000   -0.0009
   -0.0019    0.0009    1.0000


R(:,:,7) =

    1.0000    0.0032    0.0032
   -0.0032    1.0000   -0.0016
   -0.0032    0.0016    1.0000


R(:,:,8) =

    1.0000    0.0050    0.0050
   -0.0050    1.0000   -0.0025
   -0.0050    0.0025    1.0000


R(:,:,9) =

    0.9999    0.0073    0.0073
   -0.0073    1.0000   -0.0037
   -0.0073    0.0036    1.0000


R(:,:,10) =

    0.9999    0.0103    0.0103
   -0.0102    0.9999   -0.0051
   -0.0103    0.0050    0.9999


R(:,:,11) =

    0.9998    0.0138    0.0138
   -0.0137    0.9999   -0.0069
   -0.0139    0.0067    0.9999


R(:,:,12) =

    0.9997    0.0181    0.0181
   -0.0179    0.9998   -0.0091
   -0.0183    0.0087    0.9998


R(:,:,13) =

    0.9995    0.0231    0.0231
   -0.0229    0.9997   -0.0116
   -0.0234    0.0110    0.9997


R(:,:,14) =
```

```
     0.9992     0.0289     0.0289
    -0.0285     0.9995    -0.0145
    -0.0293     0.0136     0.9995


R(:,:,15) =

     0.9987     0.0355     0.0355
    -0.0349     0.9992    -0.0178
    -0.0361     0.0165     0.9992


R(:,:,16) =

     0.9982     0.0429     0.0430
    -0.0420     0.9989    -0.0215
    -0.0438     0.0196     0.9988


R(:,:,17) =

     0.9974     0.0512     0.0513
    -0.0499     0.9984    -0.0256
    -0.0525     0.0230     0.9984


R(:,:,18) =

     0.9963     0.0603     0.0604
    -0.0586     0.9978    -0.0302
    -0.0621     0.0265     0.9977


R(:,:,19) =

     0.9950     0.0703     0.0705
    -0.0680     0.9971    -0.0352
    -0.0727     0.0302     0.9969


R(:,:,20) =

     0.9934     0.0812     0.0814
    -0.0781     0.9961    -0.0406
    -0.0844     0.0340     0.9959


R(:,:,21) =

     0.9913     0.0929     0.0933
    -0.0889     0.9950    -0.0465
    -0.0971     0.0378     0.9946


R(:,:,22) =

     0.9887     0.1055     0.1061
    -0.1003     0.9936    -0.0528
    -0.1110     0.0416     0.9930


R(:,:,23) =

     0.9857     0.1189     0.1197
```

```
   -0.1124    0.9919   -0.0595
   -0.1258    0.0452    0.9910


R(:,:,24) =

    0.9820    0.1331    0.1343
   -0.1250    0.9899   -0.0667
   -0.1418    0.0487    0.9887


R(:,:,25) =

    0.9776    0.1481    0.1497
   -0.1382    0.9876   -0.0742
   -0.1589    0.0519    0.9859


R(:,:,26) =

    0.9724    0.1637    0.1660
   -0.1518    0.9850   -0.0822
   -0.1770    0.0547    0.9827


R(:,:,27) =

    0.9664    0.1801    0.1832
   -0.1658    0.9820   -0.0904
   -0.1962    0.0570    0.9789


R(:,:,28) =

    0.9595    0.1970    0.2011
   -0.1802    0.9786   -0.0990
   -0.2163    0.0588    0.9745


R(:,:,29) =

    0.9517    0.2145    0.2199
   -0.1948    0.9749   -0.1079
   -0.2375    0.0599    0.9695


R(:,:,30) =

    0.9427    0.2324    0.2393
   -0.2096    0.9708   -0.1170
   -0.2595    0.0602    0.9639


R(:,:,31) =

    0.9327    0.2506    0.2595
   -0.2245    0.9663   -0.1264
   -0.2824    0.0596    0.9574


R(:,:,32) =

    0.9214    0.2691    0.2803
   -0.2394    0.9614   -0.1359
   -0.3061    0.0581    0.9502
```

```
R(:,:,33) =

    0.9089    0.2877    0.3018
   -0.2543    0.9561   -0.1455
   -0.3304    0.0556    0.9422


R(:,:,34) =

    0.8952    0.3063    0.3237
   -0.2691    0.9505   -0.1553
   -0.3553    0.0519    0.9333


R(:,:,35) =

    0.8801    0.3248    0.3462
   -0.2837    0.9446   -0.1650
   -0.3806    0.0470    0.9235


R(:,:,36) =

    0.8637    0.3431    0.3691
   -0.2981    0.9384   -0.1746
   -0.4063    0.0408    0.9128


R(:,:,37) =

    0.8460    0.3609    0.3924
   -0.3122    0.9320   -0.1842
   -0.4322    0.0333    0.9012


R(:,:,38) =

    0.8270    0.3783    0.4160
   -0.3259    0.9254   -0.1936
   -0.4582    0.0245    0.8885


R(:,:,39) =

    0.8066    0.3950    0.4398
   -0.3393    0.9186   -0.2027
   -0.4841    0.0143    0.8749


R(:,:,40) =

    0.7849    0.4109    0.4638
   -0.3522    0.9117   -0.2116
   -0.5098    0.0027    0.8603


R(:,:,41) =

    0.7620    0.4259    0.4879
   -0.3648    0.9047   -0.2200
   -0.5351   -0.0103    0.8447
```

```
R(:,:,42) =

    0.7379    0.4398    0.5119
   -0.3768    0.8978   -0.2281
   -0.5599   -0.0246    0.8282


R(:,:,43) =

    0.7127    0.4525    0.5360
   -0.3884    0.8909   -0.2356
   -0.5841   -0.0403    0.8107


R(:,:,44) =

    0.6865    0.4639    0.5599
   -0.3995    0.8840   -0.2426
   -0.6075   -0.0571    0.7923


R(:,:,45) =

    0.6594    0.4739    0.5836
   -0.4102    0.8774   -0.2489
   -0.6300   -0.0752    0.7730


R(:,:,46) =

    0.6316    0.4824    0.6070
   -0.4204    0.8709   -0.2546
   -0.6514   -0.0944    0.7528


R(:,:,47) =

    0.6030    0.4893    0.6301
   -0.4303    0.8646   -0.2596
   -0.6717   -0.1146    0.7319


R(:,:,48) =

    0.5740    0.4945    0.6527
   -0.4397    0.8585   -0.2637
   -0.6908   -0.1356    0.7102


R(:,:,49) =

    0.5445    0.4980    0.6749
   -0.4488    0.8528   -0.2671
   -0.7085   -0.1575    0.6879


R(:,:,50) =

    0.5149    0.4998    0.6965
   -0.4576    0.8473   -0.2697
   -0.7249   -0.1799    0.6649


R(:,:,51) =
```

```
     0.4851     0.4998     0.7175
    -0.4662     0.8421    -0.2713
    -0.7398    -0.2029     0.6415


R(:,:,52) =

     0.4555     0.4980     0.7379
    -0.4745     0.8371    -0.2721
    -0.7533    -0.2262     0.6176


R(:,:,53) =

     0.4260     0.4945     0.7576
    -0.4826     0.8325    -0.2720
    -0.7652    -0.2498     0.5933


R(:,:,54) =

     0.3970     0.4893     0.7766
    -0.4906     0.8282    -0.2710
    -0.7757    -0.2734     0.5688


R(:,:,55) =

     0.3684     0.4824     0.7947
    -0.4985     0.8241    -0.2691
    -0.7847    -0.2971     0.5441


R(:,:,56) =

     0.3406     0.4739     0.8121
    -0.5064     0.8202    -0.2663
    -0.7922    -0.3205     0.5193


R(:,:,57) =

     0.3135     0.4639     0.8286
    -0.5141     0.8165    -0.2626
    -0.7984    -0.3437     0.4944


R(:,:,58) =

     0.2873     0.4525     0.8442
    -0.5219     0.8130    -0.2582
    -0.8032    -0.3664     0.4697


R(:,:,59) =

     0.2621     0.4398     0.8590
    -0.5296     0.8096    -0.2529
    -0.8067    -0.3887     0.4451


R(:,:,60) =

     0.2380     0.4259     0.8729
    -0.5374     0.8064    -0.2469
```

```
   -0.8090    -0.4104     0.4208


R(:,:,61) =

    0.2151     0.4109     0.8859
   -0.5452     0.8032    -0.2401
   -0.8103    -0.4313     0.3968


R(:,:,62) =

    0.1934     0.3950     0.8981
   -0.5530     0.8000    -0.2328
   -0.8104    -0.4516     0.3732


R(:,:,63) =

    0.1730     0.3783     0.9094
   -0.5607     0.7969    -0.2248
   -0.8097    -0.4710     0.3500


R(:,:,64) =

    0.1540     0.3609     0.9198
   -0.5685     0.7937    -0.2163
   -0.8081    -0.4896     0.3274


R(:,:,65) =

    0.1363     0.3431     0.9294
   -0.5763     0.7905    -0.2073
   -0.8058    -0.5073     0.3054


R(:,:,66) =

    0.1199     0.3248     0.9382
   -0.5840     0.7873    -0.1979
   -0.8029    -0.5241     0.2840


R(:,:,67) =

    0.1048     0.3063     0.9461
   -0.5916     0.7839    -0.1882
   -0.7994    -0.5400     0.2634


R(:,:,68) =

    0.0911     0.2877     0.9534
   -0.5992     0.7805    -0.1783
   -0.7954    -0.5550     0.2434


R(:,:,69) =

    0.0786     0.2691     0.9599
   -0.6066     0.7770    -0.1682
   -0.7911    -0.5691     0.2243
```

```
R(:,:,70) =

    0.0673    0.2506    0.9657
   -0.6139    0.7734   -0.1579
   -0.7865   -0.5822    0.2059


R(:,:,71) =

    0.0573    0.2324    0.9709
   -0.6210    0.7698   -0.1476
   -0.7817   -0.5945    0.1884


R(:,:,72) =

    0.0483    0.2145    0.9755
   -0.6279    0.7661   -0.1373
   -0.7768   -0.6059    0.1717


R(:,:,73) =

    0.0405    0.1970    0.9796
   -0.6346    0.7623   -0.1271
   -0.7718   -0.6165    0.1559


R(:,:,74) =

    0.0336    0.1801    0.9831
   -0.6411    0.7585   -0.1171
   -0.7668   -0.6263    0.1409


R(:,:,75) =

    0.0276    0.1637    0.9861
   -0.6472    0.7547   -0.1072
   -0.7618   -0.6353    0.1268


R(:,:,76) =

    0.0224    0.1481    0.9887
   -0.6531    0.7509   -0.0976
   -0.7569   -0.6436    0.1135


R(:,:,77) =

    0.0180    0.1331    0.9909
   -0.6587    0.7472   -0.0884
   -0.7522   -0.6512    0.1011


R(:,:,78) =

    0.0143    0.1189    0.9928
   -0.6640    0.7435   -0.0794
   -0.7476   -0.6581    0.0896


R(:,:,79) =
```

```
   0.0113    0.1055    0.9944
  -0.6690    0.7399   -0.0709
  -0.7432   -0.6644    0.0789


R(:,:,80) =

   0.0087    0.0929    0.9956
  -0.6736    0.7364   -0.0628
  -0.7391   -0.6701    0.0690


R(:,:,81) =

   0.0066    0.0812    0.9967
  -0.6779    0.7331   -0.0552
  -0.7351   -0.6753    0.0599


R(:,:,82) =

   0.0050    0.0703    0.9975
  -0.6819    0.7299   -0.0480
  -0.7315   -0.6799    0.0516


R(:,:,83) =

   0.0037    0.0603    0.9982
  -0.6855    0.7269   -0.0414
  -0.7281   -0.6841    0.0440


R(:,:,84) =

   0.0026    0.0512    0.9987
  -0.6888    0.7241   -0.0353
  -0.7250   -0.6878    0.0372


R(:,:,85) =

   0.0018    0.0429    0.9991
  -0.6918    0.7215   -0.0297
  -0.7221   -0.6911    0.0310


R(:,:,86) =

   0.0013    0.0355    0.9994
  -0.6944    0.7191   -0.0247
  -0.7195   -0.6940    0.0256


R(:,:,87) =

   0.0008    0.0289    0.9996
  -0.6968    0.7170   -0.0202
  -0.7173   -0.6965    0.0207


R(:,:,88) =

   0.0005    0.0231    0.9997
```

```
    -0.6989     0.7151    -0.0162
    -0.7152    -0.6987     0.0165


R(:,:,89) =

     0.0003     0.0181     0.9998
    -0.7007     0.7134    -0.0127
    -0.7135    -0.7006     0.0129


R(:,:,90) =

     0.0002     0.0138     0.9999
    -0.7022     0.7119    -0.0097
    -0.7120    -0.7021     0.0098


R(:,:,91) =

     0.0001     0.0103     0.9999
    -0.7035     0.7107    -0.0072
    -0.7107    -0.7034     0.0073


R(:,:,92) =

     0.0001     0.0073     1.0000
    -0.7045     0.7097    -0.0052
    -0.7097    -0.7045     0.0052


R(:,:,93) =

     0.0000     0.0050     1.0000
    -0.7053     0.7089    -0.0035
    -0.7089    -0.7053     0.0035


R(:,:,94) =

     0.0000     0.0032     1.0000
    -0.7060     0.7082    -0.0022
    -0.7082    -0.7060     0.0023


R(:,:,95) =

     0.0000     0.0019     1.0000
    -0.7064     0.7078    -0.0013
    -0.7078    -0.7064     0.0013


R(:,:,96) =

     0.0000     0.0010     1.0000
    -0.7068     0.7075    -0.0007
    -0.7075    -0.7068     0.0007


R(:,:,97) =

     0.0000     0.0004     1.0000
    -0.7070     0.7073    -0.0003
    -0.7073    -0.7070     0.0003
```

```
R(:,:,98) =

    0.0000    0.0001    1.0000
   -0.7071    0.7072   -0.0001
   -0.7072   -0.7071    0.0001


R(:,:,99) =

    0.0000    0.0000    1.0000
   -0.7071    0.7071   -0.0000
   -0.7071   -0.7071    0.0000


R(:,:,100) =

    0.0000   -0.0000    1.0000
   -0.7071    0.7071    0.0000
   -0.7071   -0.7071   -0.0000
```

```
tranimate(R)
```
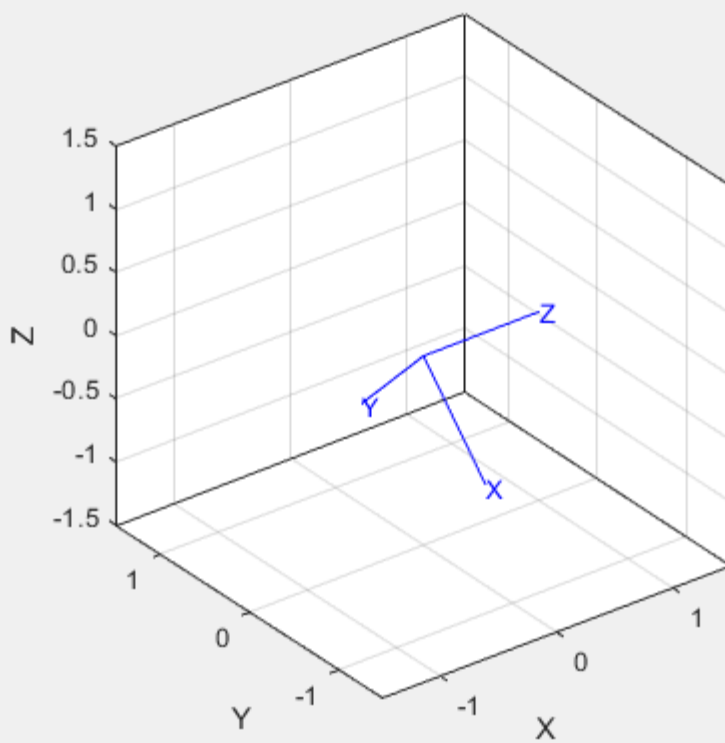


```
q1 = UnitQuaternion
```

```
q1 =

1 < 0, 0, 0 >
```

```
q2 = UnitQuaternion( rotx(pi/2) )
```

```
q2 =

0.70711 < 0.70711, 0, 0 >
```

```
initial = q1.interp(q2, 0)
```

```
initial =

1 < 0, 0, 0 >
```

```
final = q1.interp(q2, 1)
```

```
final =

0.70711 < 0.70711, 0, 0 >
```

```
halfway = q1.interp(q2, 0.5)
```

```
halfway =

0.92388 < 0.38268, 0, 0 >
```

```
T = ctraj(T0, T1, 50) %cardician trajectory of 50 time steps
```

```
T =
T(:,:,1) =

    1     0     0     0
    0     1     0     0
    0     0     1     0
    0     0     0     1


T(:,:,2) =

    1.0000   -0.0010    0.0002    0.0009
    0.0010    1.0000   -0.0014    0.0019
   -0.0002    0.0014    1.0000    0.0028
         0         0         0    1.0000


T(:,:,3) =

    1.0000   -0.0039    0.0010    0.0037
    0.0039    1.0000   -0.0057    0.0075
```

```
   -0.0009    0.0057    1.0000    0.0112
         0         0         0    1.0000


T(:,:,4) =

    1.0000   -0.0087    0.0022    0.0084
    0.0088    0.9999   -0.0128    0.0169
   -0.0021    0.0128    0.9999    0.0253
         0         0         0    1.0000


T(:,:,5) =

    0.9999   -0.0155    0.0040    0.0150
    0.0156    0.9996   -0.0227    0.0300
   -0.0036    0.0228    0.9997    0.0450
         0         0         0    1.0000


T(:,:,6) =

    0.9997   -0.0242    0.0064    0.0234
    0.0244    0.9991   -0.0355    0.0469
   -0.0055    0.0356    0.9993    0.0703
         0         0         0    1.0000


T(:,:,7) =

    0.9993   -0.0348    0.0094    0.0337
    0.0352    0.9981   -0.0511    0.0675
   -0.0076    0.0514    0.9987    0.1012
         0         0         0    1.0000


T(:,:,8) =

    0.9988   -0.0472    0.0133    0.0459
    0.0480    0.9964   -0.0694    0.0918
   -0.0100    0.0699    0.9975    0.1378
         0         0         0    1.0000


T(:,:,9) =

    0.9979   -0.0615    0.0180    0.0600
    0.0629    0.9939   -0.0904    0.1200
   -0.0123    0.0914    0.9957    0.1799
         0         0         0    1.0000


T(:,:,10) =

    0.9967   -0.0775    0.0237    0.0759
    0.0797    0.9903   -0.1142    0.1518
   -0.0146    0.1157    0.9932    0.2277
         0         0         0    1.0000


T(:,:,11) =

    0.9950   -0.0952    0.0305    0.0937
    0.0985    0.9852   -0.1405    0.1874
   -0.0167    0.1428    0.9896    0.2811
```

```
            0         0         0    1.0000


T(:,:,12) =

    0.9927   -0.1144    0.0386    0.1134
    0.1194    0.9783   -0.1693    0.2268
   -0.0184    0.1726    0.9848    0.3402
         0         0         0    1.0000


T(:,:,13) =

    0.9896   -0.1352    0.0481    0.1349
    0.1422    0.9693   -0.2004    0.2699
   -0.0195    0.2052    0.9785    0.4048
         0         0         0    1.0000


T(:,:,14) =

    0.9858   -0.1574    0.0592    0.1584
    0.1669    0.9578   -0.2338    0.3167
   -0.0199    0.2404    0.9705    0.4751
         0         0         0    1.0000


T(:,:,15) =

    0.9809   -0.1807    0.0720    0.1837
    0.1935    0.9434   -0.2692    0.3673
   -0.0193    0.2780    0.9604    0.5510
         0         0         0    1.0000


T(:,:,16) =

    0.9749   -0.2050    0.0867    0.2108
    0.2219    0.9257   -0.3064    0.4217
   -0.0174    0.3179    0.9480    0.6325
         0         0         0    1.0000


T(:,:,17) =

    0.9676   -0.2301    0.1034    0.2399
    0.2519    0.9042   -0.3450    0.4798
   -0.0141    0.3599    0.9329    0.7197
         0         0         0    1.0000


T(:,:,18) =

    0.9591   -0.2554    0.1221    0.2704
    0.2830    0.8788   -0.3842    0.5408
   -0.0092    0.4031    0.9151    0.8112
         0         0         0    1.0000


T(:,:,19) =

    0.9495   -0.2797    0.1420    0.3010
    0.3136    0.8506   -0.4221    0.6020
   -0.0027    0.4454    0.8953    0.9031
         0         0         0    1.0000
```

```
T(:,:,20) =

    0.9391   -0.3026    0.1628    0.3316
    0.3436    0.8196   -0.4584    0.6633
    0.0053    0.4865    0.8737    0.9949
         0         0         0    1.0000


T(:,:,21) =

    0.9278   -0.3242    0.1846    0.3622
    0.3728    0.7861   -0.4930    0.7245
    0.0147    0.5262    0.8502    1.0867
         0         0         0    1.0000


T(:,:,22) =

    0.9156   -0.3444    0.2073    0.3929
    0.4012    0.7501   -0.5257    0.7857
    0.0255    0.5646    0.8250    1.1786
         0         0         0    1.0000


T(:,:,23) =

    0.9027   -0.3631    0.2308    0.4235
    0.4286    0.7117   -0.5565    0.8469
    0.0378    0.6013    0.7981    1.2704
         0         0         0    1.0000


T(:,:,24) =

    0.8890   -0.3803    0.2551    0.4541
    0.4551    0.6711   -0.5852    0.9082
    0.0514    0.6363    0.7697    1.3622
         0         0         0    1.0000


T(:,:,25) =

    0.8746   -0.3959    0.2800    0.4847
    0.4804    0.6284   -0.6118    0.9694
    0.0663    0.6696    0.7398    1.4541
         0         0         0    1.0000


T(:,:,26) =

    0.8595   -0.4099    0.3054    0.5153
    0.5045    0.5837   -0.6362    1.0306
    0.0825    0.7009    0.7085    1.5459
         0         0         0    1.0000


T(:,:,27) =

    0.8438   -0.4222    0.3314    0.5459
    0.5273    0.5372   -0.6583    1.0918
    0.0999    0.7302    0.6759    1.6378
         0         0         0    1.0000
```

```
T(:,:,28) =

    0.8275   -0.4327    0.3577    0.5765
    0.5488    0.4890   -0.6780    1.1531
    0.1184    0.7573    0.6422    1.7296
         0         0         0    1.0000


T(:,:,29) =

    0.8107   -0.4415    0.3844    0.6071
    0.5689    0.4393   -0.6952    1.2143
    0.1381    0.7823    0.6074    1.8214
         0         0         0    1.0000


T(:,:,30) =

    0.7935   -0.4485    0.4113    0.6378
    0.5875    0.3883   -0.7100    1.2755
    0.1587    0.8050    0.5716    1.9133
         0         0         0    1.0000


T(:,:,31) =

    0.7758   -0.4537    0.4384    0.6684
    0.6046    0.3360   -0.7222    1.3367
    0.1804    0.8254    0.5350    2.0051
         0         0         0    1.0000


T(:,:,32) =

    0.7579   -0.4571    0.4655    0.6990
    0.6201    0.2827   -0.7318    1.3980
    0.2029    0.8433    0.4977    2.0969
         0         0         0    1.0000


T(:,:,33) =

    0.7396   -0.4586    0.4926    0.7296
    0.6339    0.2286   -0.7389    1.4592
    0.2263    0.8587    0.4598    2.1888
         0         0         0    1.0000


T(:,:,34) =

    0.7211   -0.4583    0.5195    0.7601
    0.6460    0.1739   -0.7432    1.5202
    0.2503    0.8716    0.4215    2.2803
         0         0         0    1.0000


T(:,:,35) =

    0.7034   -0.4563    0.5450    0.7892
    0.6559    0.1215   -0.7450    1.5783
    0.2738    0.8815    0.3848    2.3675
         0         0         0    1.0000
```

```
T(:,:,36) =

    0.6867   -0.4530    0.5685    0.8163
    0.6638    0.0721   -0.7444    1.6327
    0.2962    0.8886    0.3502    2.4490
         0         0         0    1.0000


T(:,:,37) =

    0.6712   -0.4486    0.5902    0.8416
    0.6699    0.0260   -0.7420    1.6833
    0.3175    0.8934    0.3179    2.5249
         0         0         0    1.0000


T(:,:,38) =

    0.6568   -0.4434    0.6100    0.8651
    0.6744   -0.0167   -0.7382    1.7301
    0.3375    0.8962    0.2880    2.5952
         0         0         0    1.0000


T(:,:,39) =

    0.6435   -0.4376    0.6280    0.8866
    0.6776   -0.0559   -0.7333    1.7732
    0.3561    0.8974    0.2605    2.6598
         0         0         0    1.0000


T(:,:,40) =

    0.6315   -0.4317    0.6441    0.9063
    0.6797   -0.0917   -0.7277    1.8126
    0.3732    0.8974    0.2355    2.7189
         0         0         0    1.0000


T(:,:,41) =

    0.6206   -0.4256    0.6586    0.9241
    0.6810   -0.1238   -0.7218    1.8482
    0.3888    0.8964    0.2130    2.7723
         0         0         0    1.0000


T(:,:,42) =

    0.6109   -0.4197    0.6713    0.9400
    0.6816   -0.1525   -0.7157    1.8800
    0.4028    0.8947    0.1929    2.8201
         0         0         0    1.0000


T(:,:,43) =

    0.6024   -0.4141    0.6823    0.9541
    0.6817   -0.1777   -0.7097    1.9082
    0.4152    0.8927    0.1753    2.8622
         0         0         0    1.0000


T(:,:,44) =
```

```
   0.5951   -0.4090    0.6918    0.9663
   0.6815   -0.1994   -0.7041    1.9325
   0.4259    0.8905    0.1601    2.8988
        0         0         0    1.0000


T(:,:,45) =

   0.5889   -0.4044    0.6997    0.9766
   0.6811   -0.2177   -0.6991    1.9531
   0.4350    0.8883    0.1473    2.9297
        0         0         0    1.0000


T(:,:,46) =

   0.5839   -0.4006    0.7061    0.9850
   0.6806   -0.2326   -0.6947    1.9700
   0.4425    0.8863    0.1368    2.9550
        0         0         0    1.0000


T(:,:,47) =

   0.5800   -0.3975    0.7111    0.9916
   0.6801   -0.2441   -0.6912    1.9831
   0.4483    0.8845    0.1288    2.9747
        0         0         0    1.0000


T(:,:,48) =

   0.5772   -0.3952    0.7146    0.9963
   0.6798   -0.2523   -0.6887    1.9925
   0.4525    0.8833    0.1230    2.9888
        0         0         0    1.0000


T(:,:,49) =

   0.5756   -0.3939    0.7167    0.9991
   0.6795   -0.2572   -0.6871    1.9981
   0.4550    0.8824    0.1196    2.9972
        0         0         0    1.0000


T(:,:,50) =

   0.5750   -0.3934    0.7174    1.0000
   0.6794   -0.2589   -0.6866    2.0000
   0.4558    0.8822    0.1184    3.0000
        0         0         0    1.0000
```

```
tranimate(T)
```