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function [traj] = TrajectoryGenerator(T_se_initial, T_sc_initial, T_sc_final, T_ce_grasp, T_ce_standoff, k)
% Trajectory Generator
% Inputs:
%   - T_se_initial: This is the initial configuration of the
%                   end-effector
%   - T_sc_initial: The initial configuration of the cube
%   - T_sc_final:   The final configuration of the cube
%   - T_ce_grasp:   The configuration of the end-effector relative to
%                   the cube, while grasping
%   - T_ce_standoff: The standoff configuration of the end-effector
%                   above the cube, before and after grasping
%   - k:            The number of trajectory reference configurations
%                   per 0.01 seconds.
% Outputs:
%   - traj : A representation of the N configurations of the
%             end-effector along the entire concatenated eight-segment
%             reference trajectory.

addpath('external/ModernRobotics/packages/MATLAB/mr')

% delete old csv file
delete('trajectory.csv')

N = k / 0.01;

T_se_standoff_intial = T_sc_initial * T_ce_standoff;

T_se_standoff_final = T_sc_final * T_ce_standoff;
T_se_standoff_final(3,4) = 0.15;

T_se_grasp_final = T_se_standoff_final;
T_se_grasp_final(3,4) = 0.05;

% Starting Position --> Standoff over Cube
traj1 = ScrewTrajectory(T_se_initial, T_se_standoff_intial, 3, N, 5);
trajectoryToCsv(traj1, 0)

% Standoff over Cube --> To End-Effector Grasp
traj2 = ScrewTrajectory(T_se_standoff_intial, T_ce_grasp, 1, N, 5);
trajectoryToCsv(traj2, 0)

% End-Effector Grasp --> End-Effector Grasp 0.625
traj3 = ScrewTrajectory(T_ce_grasp, T_ce_grasp, 1, N, 5);
trajectoryToCsv(traj3, 1)

% End-Effector Grasp --> Standoff over Cube
traj4 = ScrewTrajectory(T_ce_grasp, T_se_standoff_intial, 2, N, 5);
trajectoryToCsv(traj4, 1)

% Standoff over Cube Initial --> Standoff over Cube Final
traj5 = ScrewTrajectory(T_se_standoff_intial, T_se_standoff_final, 3, N, 5);
trajectoryToCsv(traj5, 1)

% Standoff over Cube Final --> End-Effector Grasp
traj6 = ScrewTrajectory(T_se_standoff_final, T_se_grasp_final, 2, N, 5);
trajectoryToCsv(traj6, 1)

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% End-Effector Grasp --> End-Effector Grasp 0.625
traj7 = ScrewTrajectory(T_se_grasp_final, T_se_grasp_final, 1, N, 5);
trajectoryToCsv(traj7, 0)

% End-Effector Grasp --> End-Effector Standoff
traj8 = ScrewTrajectory(T_se_grasp_final, T_se_standoff_final, 1, N, 5);
trajectoryToCsv(traj8, 0)

traj = [traj1, traj2, traj3, traj4, traj5, traj6, traj7, traj8];

end

function trajectoryToCsv(traj, gripperState)

    for ii = 1:length(traj)
        [R, p] = TransToRp( traj{1,ii} );
        segmentCsv = [reshape(R.',1,[]), p', gripperState];
        writematrix(segmentCsv, 'trajectory.csv', 'WriteMode','append')
    end

end

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% Number of trajectory reference configurations per 0.01 seconds: k
k = 1;

% Define Inputs
T_se_initial = eye(4);
T_se_initial(3,4) = 0.5;

T_sc_initial = [[1, 0, 0, 1]; [0, 1, 0, 0]; [0, 0, 1, 0.05]; [0, 0, 0, 1]];

T_sc_final = [[0, 1, 0, 0]; [-1, 0, 0, -1]; [0, 0, 1, 0.05]; [0, 0, 0, 1]];

T_ce_standoff = [[0, 0, 1, 0]; [0, 1, 0, 0]; [-1, 0, 0, 0.20]; [0, 0, 0, 1]];

T_ce_grasp = [[0, 0, 1, 1]; [0, 1, 0, 0]; [-1, 0, 0, 0.05]; [0, 0, 0, 1]];

[traj] = TrajectoryGenerator(T_se_initial, T_sc_initial, T_sc_final, T_ce_grasp, T_ce_standoff, k);
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Milestone 1 Video Link:

<https://youtu.be/e2LU5RfEfvs>