

READ ME

General Instructions:

- As per the submission guidelines, there are two folders present, 'Code' and 'Results'.
- The directory 'Code', has a MATLAB file 'Project_Code', which is the main executable file.
- The directory 'Code' also has a folder 'Functions' which has all the new functions stored in it.
- The 'Results' directory has been split into 'Best', 'Overshoot' and 'New Task'. Every folder has script files which have inputs for those specific cases. The grader may copy those inputs and paste them in the designated area (marked by comments) in the start of 'Project_Code'.
- In shooting the videos, certain parts have been sped up while certain parts have been run at normal speeds. This has been done to keep the videos of reasonable length without compromising quality.
- The wheels of the YouBot do not appear to spin due to poor graphic qualities of the system used.

Changes to Functions:

- In 'NextState' function, wheel speed limits and joint angle limits have been separated as 2 inputs rather than 1 input to allow more flexibility.
- In the 'TrajectoryGenerator' function, 'k' has been taken as 1, so its input has been removed.
- Each trajectory segment has been given independent T and N values so that enough reference points can be plotted/obtained.
- Also in 'TrajectoryGenerator', the grasp and standoff with respect to the cube have been slightly modified. The function uses the cube's initial location to calculate the standoff and grasp locations. Hence, when the cube is moved the function can modify itself automatically.
- In the 'TrajectoryGenerator', an input for 'gripper state' has been added so that the trajectories generated automatically take the input from the function.

New Functions:

- A new function 'chassistwister' has been created as a subset of 'NextState'. It takes calculates new chassis configuration (using phi,x,y) and also imposes wheel-speed limits.
- A new function 'lin1324' (read, Linear 13 to 4), has been created. Its purpose is to generate 4x4 matrices based on a linear 13 vector configuration and 2 other transformation matrices, (Here, Toe,Tbo).

Code Explanation:

The functioning of the code (integration of all milestones) is explained below:

- Taking location inputs for cube, gripper and reference trajectory, the 'TrajectoryGenerator' function creates 8 segments of trajectories, which are combined in one matrix, P.
- We input data such as: starting configuration (linear, 13 vector) YouBot, Ki & Kp values, time-step, and joint and wheel angle limits.
- Using bot geometry data, we create the combined base and arm jacobian.
- Using the twist from 'FeedbackControl' function & the Bot jacobian, we generate the 9 vector joint speeds.
- Feeding the current linear 13 configuration and new joint speeds, we obtain the new Linear 13 vector configuration (phi,x,y,j1,j2,j3,j4,j5,w1,w2,w3,w4,gs). Gripper state is taken directly from reference trajectory.
- Tuning of Kp, Ki and wheel speed values was done by plotting 'phi', 'x' and 'y' from all configurations and monitoring their behavior.

Difficulties/Problems:

- On giving a suitable offset to the bot, it hurriedly arrives to the starting position of the reference trajectory. No matter how much tuning was done, the initial adjustment could not be smoothed out.