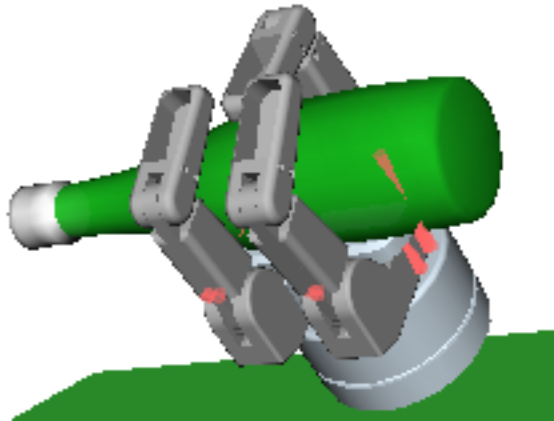


16662 – Robot Autonomy

Hw1 – Grasps

Shao-Po Ma(shaopom), Konduri Vamshi (kvk), Ardy Dipta Nandaviri (agiri)

- Try out the openrave grasps on the champagne bottle - put in a picture of the top rated one. Do you think they will work in practice? (1 pt)



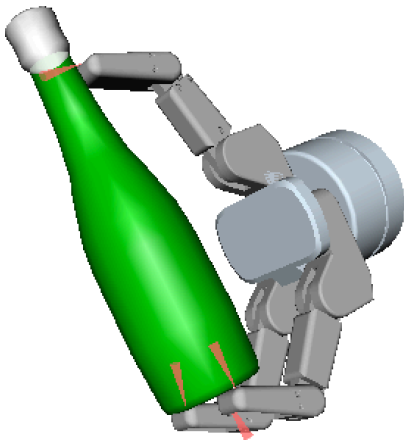
It can work in practice, if we consider only the hand of the robot. It will not work if the whole robot arm is placed, for the reason that here we only consider about the grasp planning, not the arm planning.

- Come up with an evaluation function for testing grasps. Describe it in your writeup. Put in images of your top 4 ranked grasps for each of the items in your writeup. (10 pts)

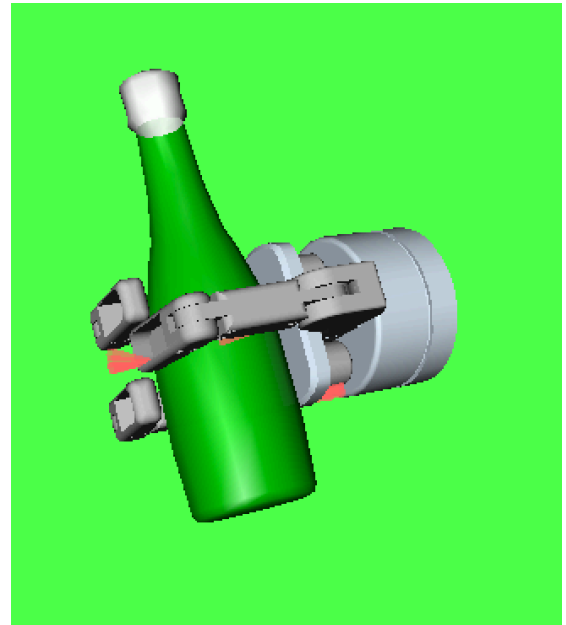
1. Evaluated by the minimum Eigen value for each grasp.
2. Evaluated by the ratio between the minimum and maximum Eigen value.
3. Evaluated by the Multiplication all the Eigen values. (Volume)

We normalize them by L1 norm = 1, and use different weights to add them together. In our case, we use $[0.2, 0.6, 0.2]$, giving the second metric a higher weight.

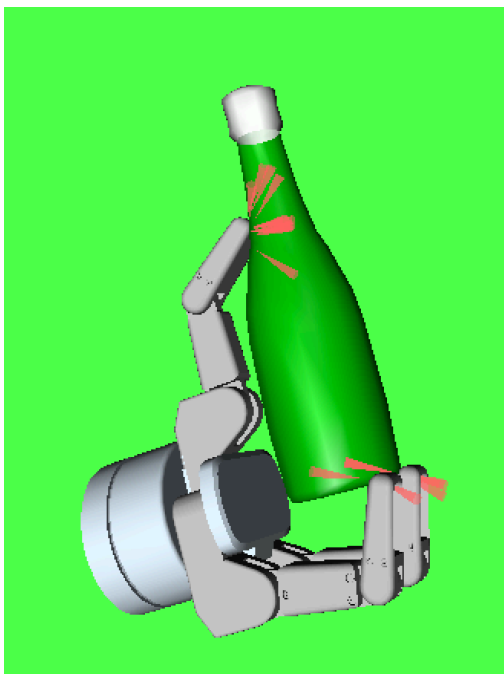
Champagne Bottle:



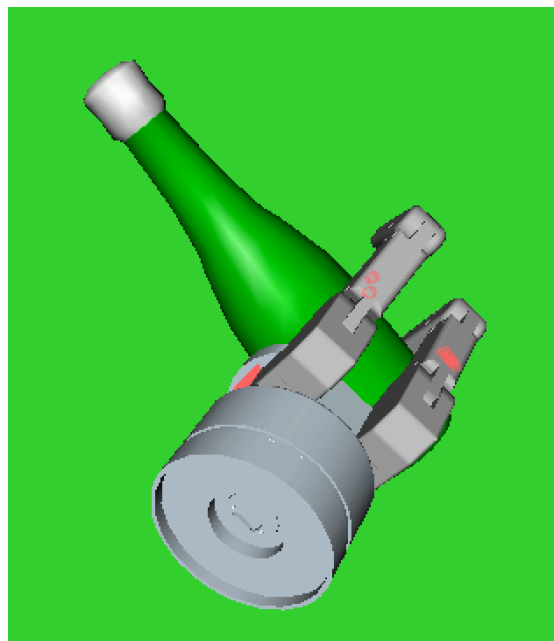
`robo.grasp_ordered[0]`



`robo.grasp_ordered[1]`

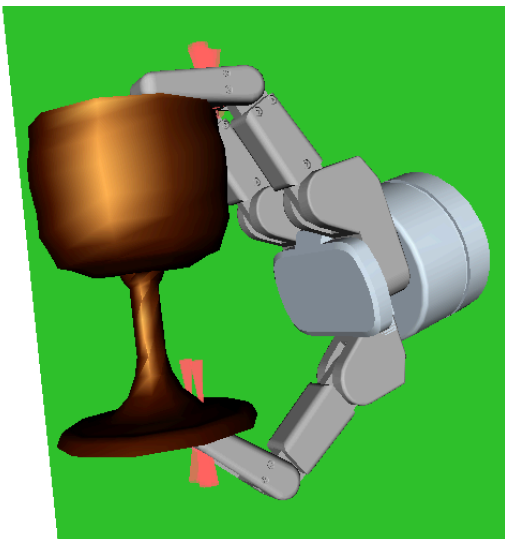


robo.grasp_ordered[2]

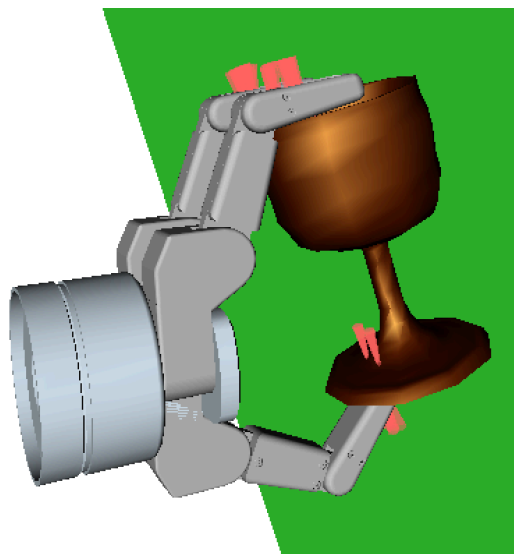


robo.grasp_ordered[3]

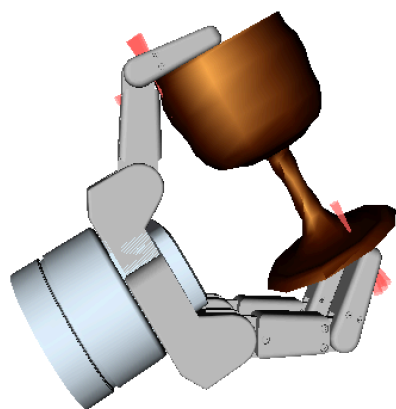
Goblet



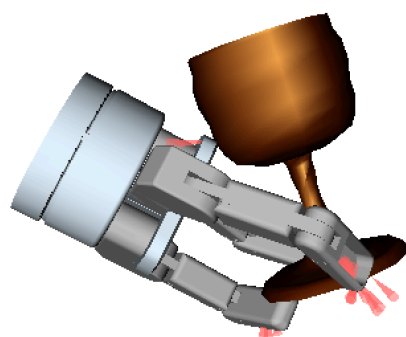
robo.grasp_ordered[0]



robo.grasp_ordered[1]

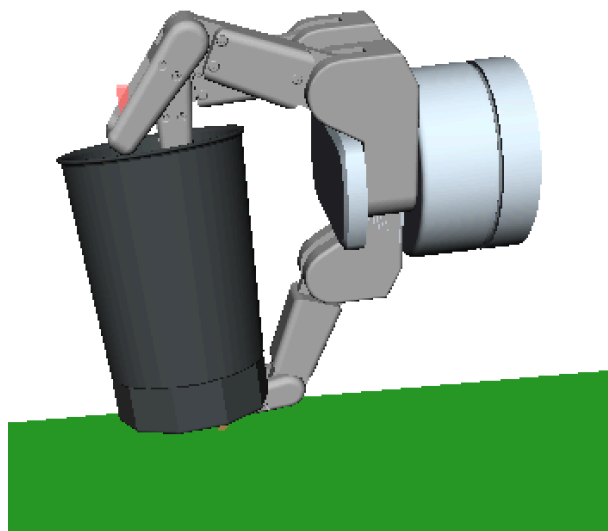


`robo.grasp_ordered[2]`

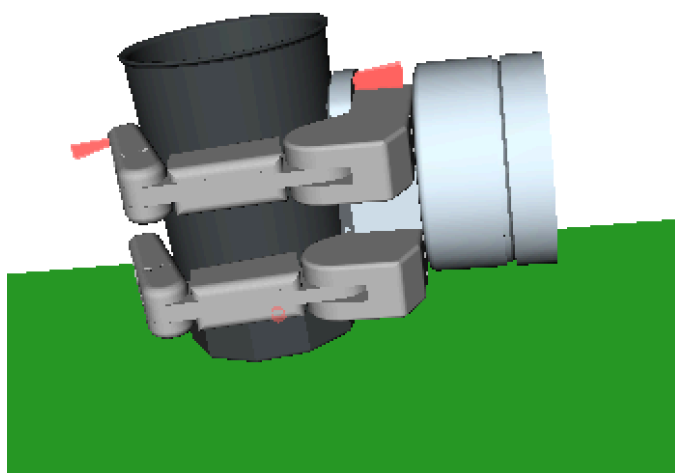


`robo.grasp_ordered[3]`

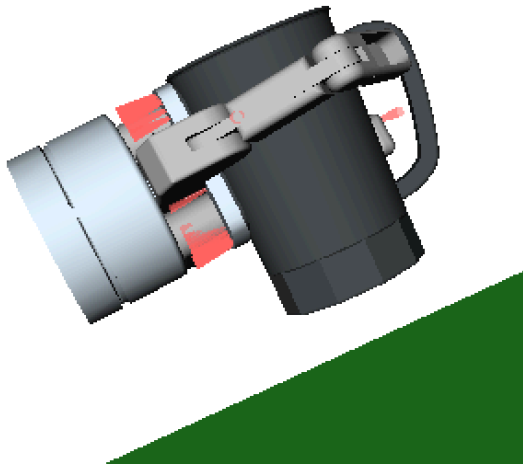
Black Mug



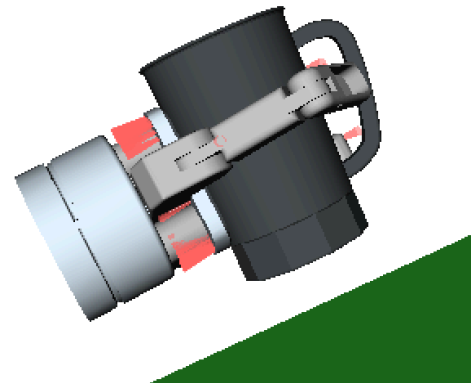
`robo.grasp_ordered[0]`



`robo.grasp_ordered[1]`



robo.grasp_ordered[2]



robo.grasp_ordered[3]

- Complete the code to sample a new position and orientation for a grasp (5 pts)

We used a Gaussian distribution with deviation: 0.01 for position, and $\pi/24$ for the orientation. Please check this function in our code:

sample_random_grasp

Here we use Numpy's random number generator to generate Gaussian distribution, as follows,

pos_orig = np.random.normal(pos_orig, RAND_DIST_SIGMA, 3)

- Complete the code in order grasps_noisy.py to evaluate the random samples and combine them. Put in images of the top 4 ranked grasps for each item in the writeup. Did adding noise help? How did you decide to combine the noisy scores? (3 pts)

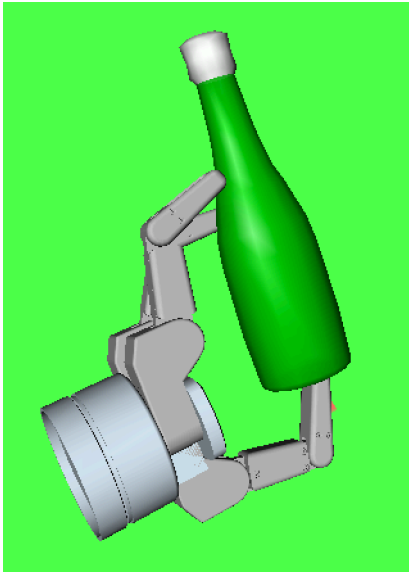
Adding noise makes the grasping much robust in some cases. In our case, we generate four random grasps, and combine the score of them and the original grasp. We combine the noisy score by giving weight 1/2 for the original grasp score and 1/8 for each of the four random grasp scores.

1 original grasp, score: (S1)

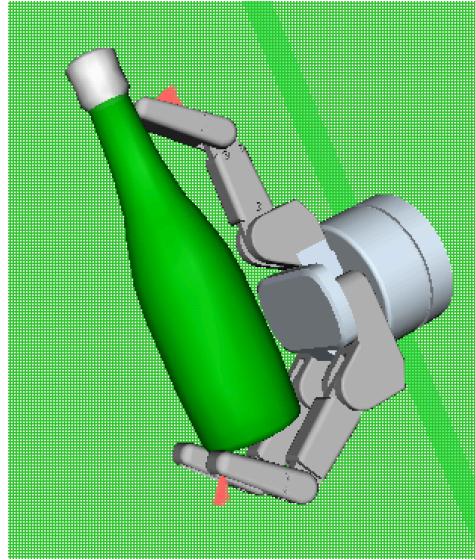
4 random grasps, scores: (S2, S3, S4, S5)

Combined Score = $S1 * 1/2 + (S2 + S3 + S4 + S5) * 1/8$

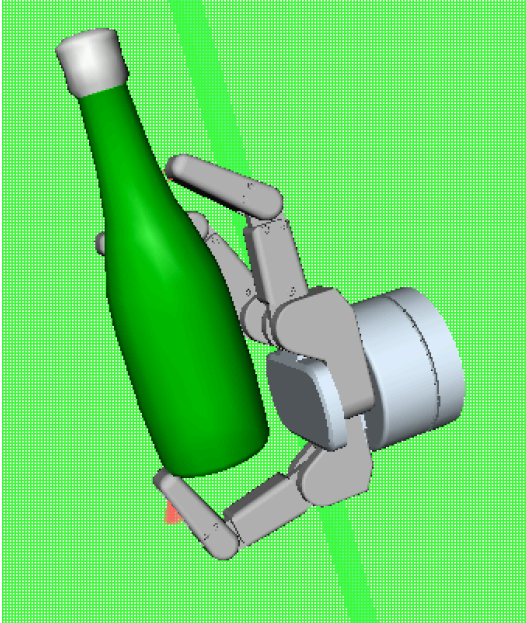
Champagne Bottle



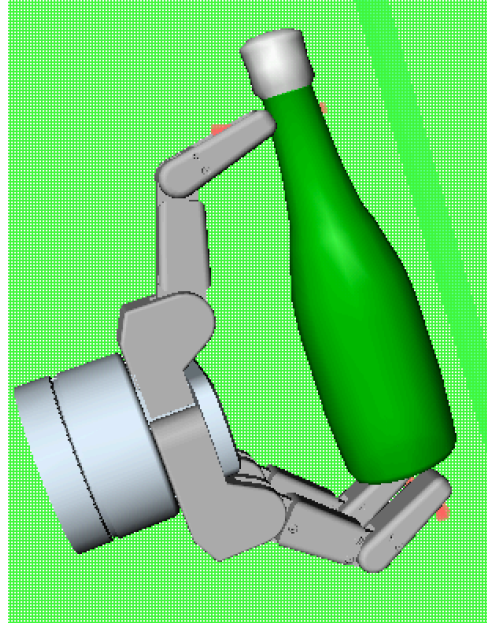
grasps_ordered_noisy[0]



grasps_ordered_noisy[1]

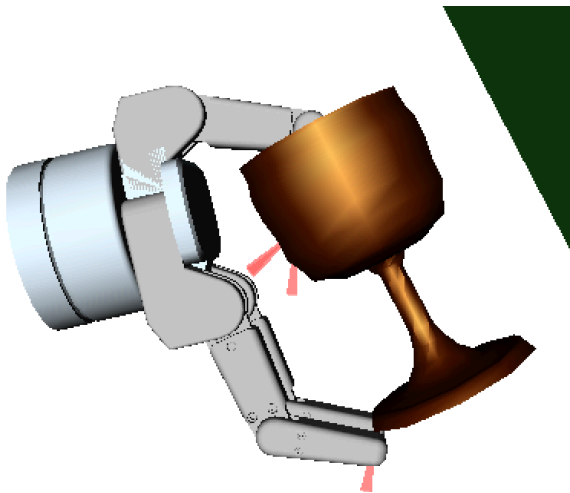


grasps_ordered_noisy[2]

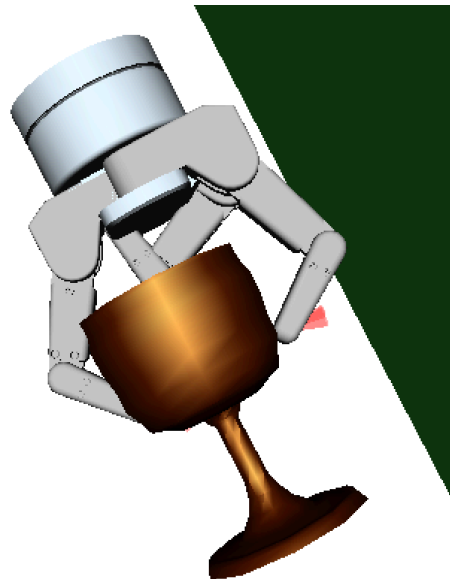


grasps_ordered_noisy[3]

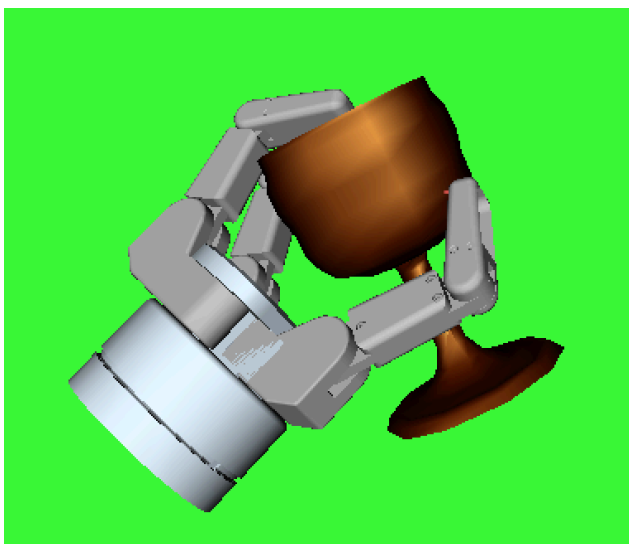
Goblet



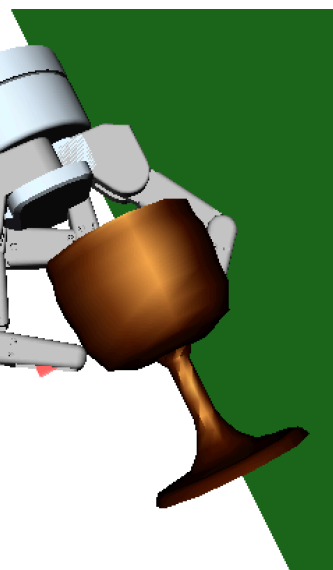
grasps_ordered_noisy[0]



grasps_ordered_noisy[1]

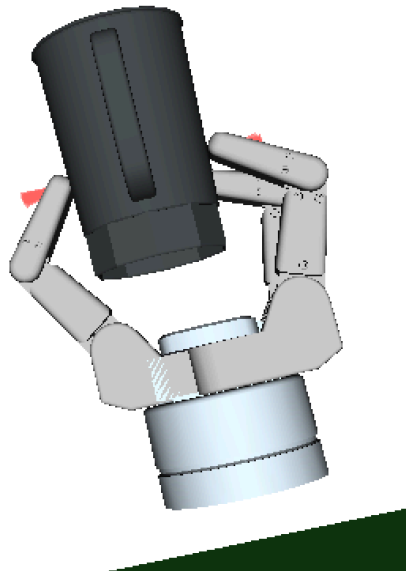


grasps_ordered_noisy[2]

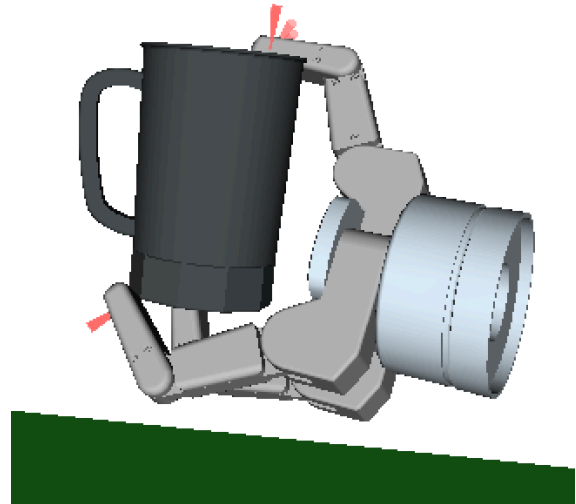


grasps_ordered_noisy[3]

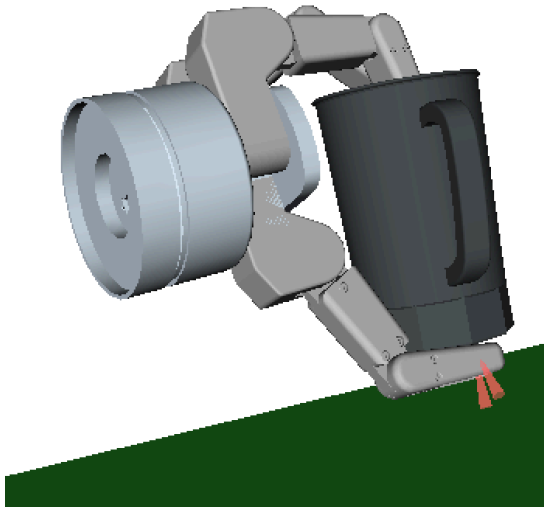
Black Mug



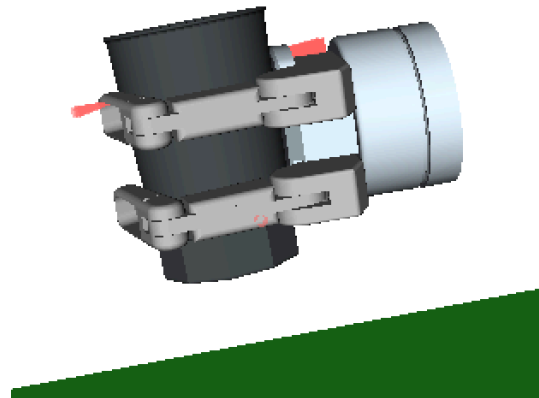
grasps_ordered_noisy[0]



grasps_ordered_noisy[1]



grasps_ordered_noisy[2]



grasps_ordered_noisy[3]

- Tell me how long this homework took you. (1 pt)

We spent 8 hours on this assignment.