Prathamesh Vibhute Date:1/10/21

18110186 Midsem: Introduction to Robotics

Q.2

a.

In my opinion a compliant/soft gripper should be more suitable for the task. A pill is not a very strong object. A hard gripper might break it while gripping if the gripping force is too much. A soft gripper on the contrary will absorb some of the force and grip the pill gently. It would be easier to grab a pill of round shape with a soft gripper. A hard gripper won't cover the complete shape of the pill and just hold it on two points on the surface of the pill. A soft gripper will mold its shape to hold the pill with a larger surface area. As the surface area of contact is increased the gripping pressure acting on the pill will be lesser than that in case of a hard gripper. In the hard robotic gripper, we must know the exact precise location of the object to be picked.

b.

Flexible Mechanisms:

It is a mechanism in which achieves the force and motion transmission through elastic body deformation. It uses elasticity of the material for the movement instead of the classic joints. It can be done using servo motors.

COMPLIANT MECHANISMS COMPILATION - YouTube

Soft robotic grippers:

Similar to the compliant/flexible mechanism the soft robotic grippers adapt variation in size and shape. It is made of elastomeric materials like rubber with number of channels into it for flow of fluids. The information regarding shape and size of the object to be picked is not required.

(2) Soft Robotics' octopus-inspired robots industrial grippers - YouTube

Universal grippers:

It replaces individual fingers with moldable material which molds itself around the object to grab it. There are infinite degrees of freedom in such gripper. A wide variety of object can be picked and placed using this gripper. In the video below, the gripper is made of a single non porous elastic bag filled with granular matter.

Universal Robotic Gripper (wevolver.com)

Paper grippers:

These grippers are made up of paper. The paper is cut in a certain way to provide it structural strength to grab and hold an object. The act of paper cutting is a Japanese art called as Kirigami.

It is often called as the cousin of origami. The video shown below is gripper made up a paper with the help of Kirigami,

(7) This Robot's Soft Gripper Was Inspired By Japanese Kirigami - YouTube

Origami robots: The bodies of the origami robots are made up of dynamic folds that act together for actuation. These are strong and flexible. The wide variety of objects of different sizes and shapes can be picked.

(7) Origami Robot Gripper - YouTube

Suitable for Our task: Universal Gripper, Paper Gripper and Origami Gripper

Q.3

a.

My own measurements

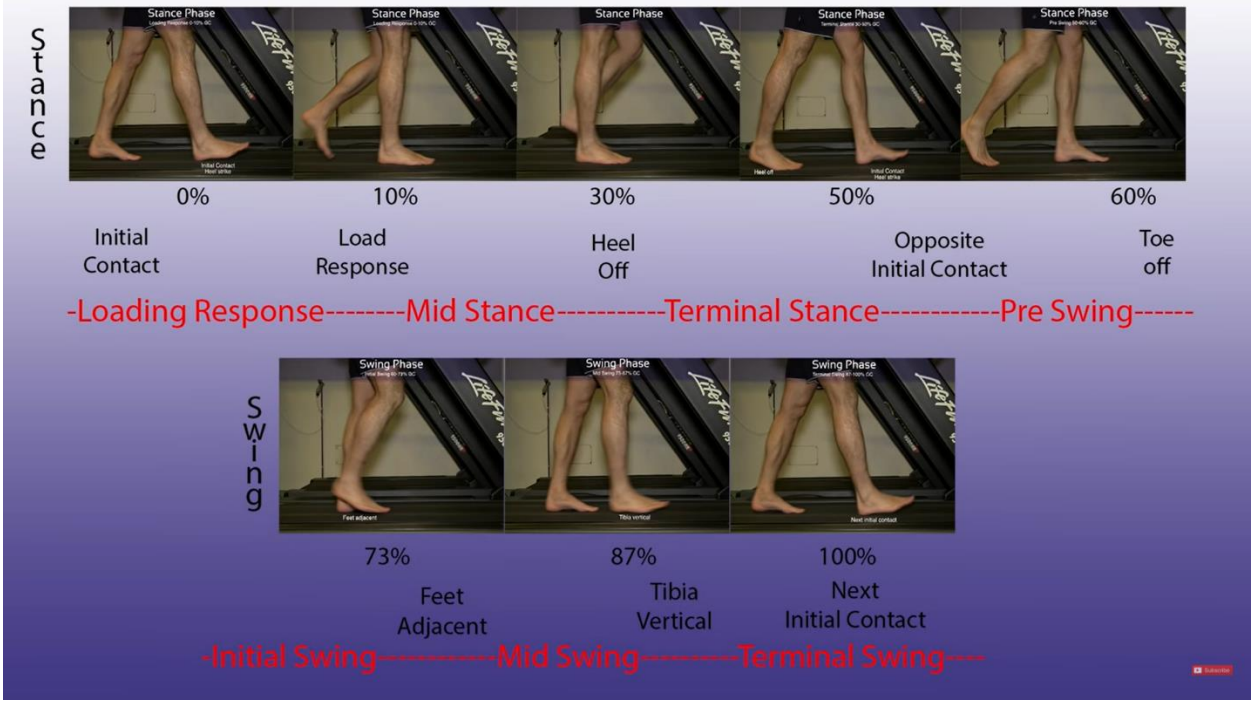
1st link- Hip to knee =40 cm

2nd link- knee to ankle= 45 cm

Gait trajectory:

A gait cycle comprises of two human steps. The cycle starts when the foot is touched to the ground (heel strike) at the time of new step and ends when at the new step from the same foot. The successful cycle must complete 3 tasks: Weight acceptance, single limb support, limb advancement.

The gait cycle is separated into two main sections as STANCE and SWING. 60% of the gait cycle is in stance phase and the rest in swing phase. In the stance phase the reference limb is in contact with the ground while in the swing phase is it in the air.



Step height: The maximum vertical distance the heel of a limb travels during a gait cycle is called the step height.

Step length: It is the linear distance from the heel strike of reference limb to the next heel strike of opposite limb. Similarly, the linear distance from the heel strike of the reference limb to the next heel strike of the same limb is called the stride length.

Q.4

a.

There are 4 parameters in the DH convention. They are a, alpha, d and theta. In DH parameter convention the z axis is aligned with the joint axes. The only parameter varying in the robot with a single link and a single revolute joint is the angle subtended by the link about the axis of the revolute joint. Therefore, the DH parameters for the robot are

a	Alpha	d	Theta
L	0	0	Θ

Q.5

Yes, in DH parameter convention the z axis is aligned with the joint axes.

Q.6

Yes, in the DH convention the origins of all coordinate frames are at the center of the joints.

Q.7

Yes, it is true that a homogenous matrix consists of both a rotation and a translation.

$$H = \begin{bmatrix} R & \boldsymbol{d} \\ \mathbf{0} & 1 \end{bmatrix}; R \in SO(3).$$

Here, H is the homogenous matrix. R is the rotational element and d is the translational element. R forms the top 3 rows and left 3 columns while d forms the right most columns of the first three rows.

Q.8

Yes, rotation matrices for each individual rotation can be multiplied together to form the overall rotation matrix. It also captures sequence of rotations.

Q.9

Yes, a composite rotation matrix consisting of a sequence of several rotations is still an orthogonal matrix with determinant equal to 1.