

Computer Graphics, Lab Assignment 10

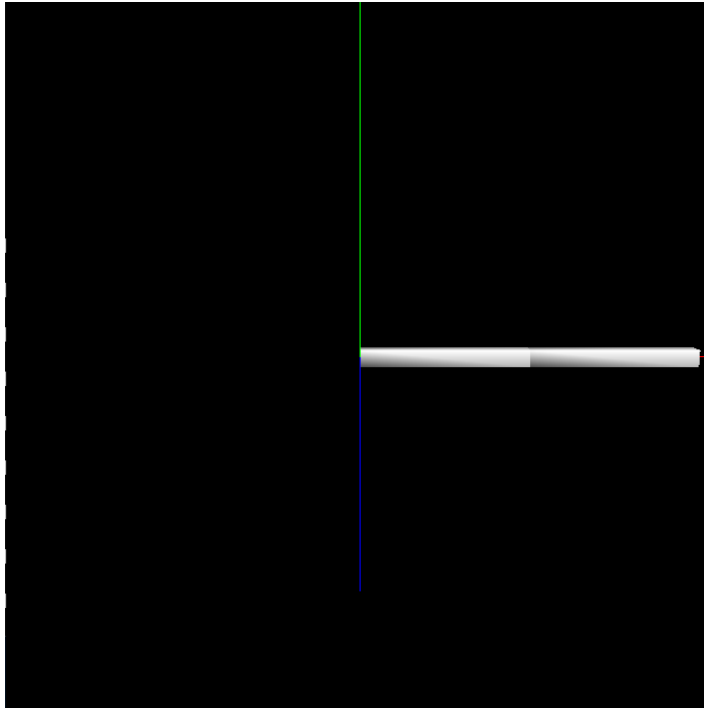
Handed out: May 11, 2021

Due: 23:59, May 11, 2021 (NO SCORE for late submissions!)

- Only accept answers submitted via git push to this course project for you at <https://hconnect.hanyang.ac.kr> (<Year>_<Course no.>_<Class code>/<Year>_<Course no.>_<Student ID>.git).
- Place your files under the directory structure <Assignment name>/<Problem no.>/<your file> just like the following example.

```
+ 2021_ITE0000_2019000001
+ LabAssignment10/
+ 1/
+   - 1.py
+ 2/
+   - 2.py
+ 3/
+   - 3.py
```

- The submission time is determined not when the commit is made but when the git push is made.
 -
1. Write down a Python program to calculate end point and velocity of 2-joint arm, using forward kinematics.
 - A. Set the window title to your student ID and the window size to (640, 640)
 - B. Start from LabAssignment10-code-skeleton.py.
 - i. When program begin, you can see white boxes(2 joint arm) on x axis.
 - ii. You can rotate these boxes by changing matrix R1 and R2.
 - iii. R1 and R2 should be calculated by XYZ Euler Angles.



iv.

- C. You should rotate 2 joints, by changing rotation matrix $R1$ and $R2$.
 - i. The joint $R1$ should be t rad rotated by Y axis when t seconds have elapsed since the program was executed. (Rotation angle for X , Z axis is 0)
 - ii. The joint $R2$ should be t rad rotated by X axis and t rad rotated by Z axis when t seconds have elapsed since the program was executed. (Rotation angle for Y axis is 0)
- D. You should mark end point of arm, with some lines or little box.
 - i. End point is center of second joint's outer plane.
- E. You should draw line for showing velocity of end point.
 - i. The velocity vector can be calculated between current end point and before end point.
 - ii. Multiply 10 to the length of line(magnitude of velocity vector) for visible.
 - iii. The velocity vector is started at current end point and direction is to next frame.
- F. Expected result: Uploaded LabAssignment10-1.mp4
 - i. To compare your result with video, rotate camera by press key '3', 4 times.
- G. Files to submit: A Python source file (Name the file whatever you want (in English). (Extension should be .py)

2. Write down a Python program to show animation of 2-joint arm, using interpolation of rotation matrix.

- A. Set the window title to your student ID and the window size to (640, 640)
- B. Start from LabAssignment10-code-skeleton.py. It is same as lab assignment 10-1.
- C. You should make 61 frames animation(0 ~ 60).
- D. Frame 0, Frame 20, Frame 40, Frame60 was given. You can calculate R1 and R2 to draw each frame. Make inner frames using interpolation method(Slerp) that you implemented at LabAssignment9.

Frame	Rotation(XYZ Euler Angle, degree)
0	(R1: X 20 Y 30 Z 30) (R2: X 15 Y 30 Z 25)
20	(R1: X 45 Y 60 Z 40) (R2: X 25 Y 40 Z 40)
40	(R1: X 60 Y 70 Z 50) (R2: X 40 Y 60 Z 50)
60	(R1: X 80 Y 85 Z 70) (R2: X 55 Y 80 Z 65)

- E. Use red color for 0 frame, yellow color for 20 frame, green color for 40 frame, blue color for 60 frame and white color for all inner frames.
- F. Expected result: Uploaded LabAssignment10-2.mp4
 - i. To compare your result with video, rotate camera by press key '3', 4 times.
- G. Files to submit: A Python source file (Name the file whatever you want (in English). (Extension should be .py)