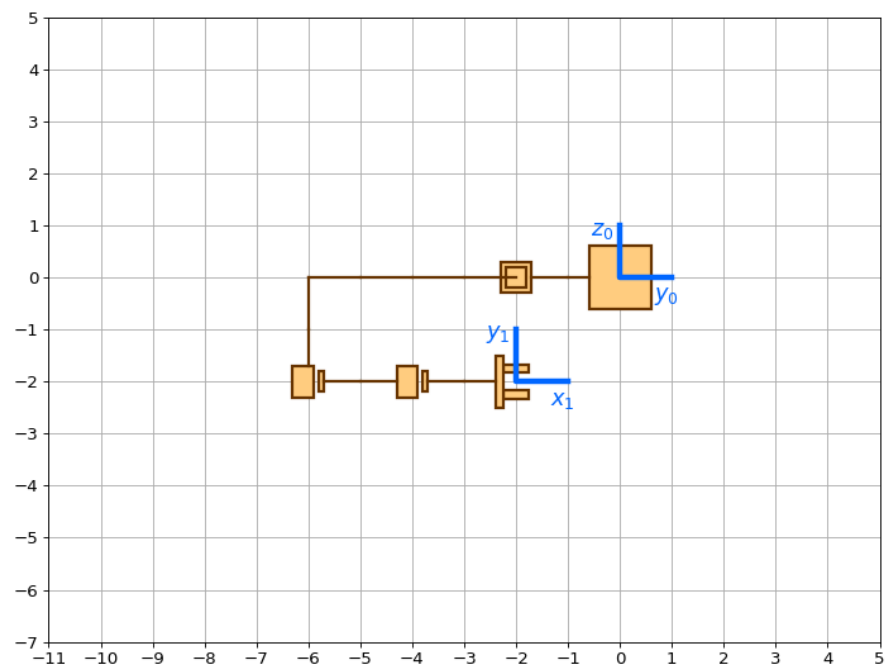


HW5.3. Derive the forward kinematics of a robot with several joints



The schematic of a robot with 3 joints (in the zero position) is shown above. Frame 0 is fixed to the base. Frame 1 is fixed to the tool. Find the homogeneous transformation matrix  $M$  and the screw axes  $\mathcal{S}_1, \dots, \mathcal{S}_3$  so that the pose of frame 1 can be expressed as

$$T_1^0 = e^{[\mathcal{S}_1]\theta_1} \dots e^{[\mathcal{S}_3]\theta_3} M,$$

where  $\theta_1, \dots, \theta_3$  are the joint variables. Express your answer as a single matrix  $\mathcal{S}$  of size  $6 \times 3$ , with the screw axis associated with joint  $i$  in column  $i$ .

Assume revolute joints are represented as rectangles with the axis of rotation parallel to the longer rectangle side and centered in the rectangle (axis pointing towards the segment out of the rectangle) or by circles if the axis of rotation is orthogonal to the figure (axis pointing outside the screen).

Assume prismatic joints are represented as two rectangles separated by a small gap, with the axis of translation along the line between the midpoints of the two rectangles (axis pointing towards the small rectangle) or by two squares on top of each other if the axis of translation is orthogonal to the figure (axis pointing outside the screen).

$M =$

matrix (rtol=0.01, atol=1e-08)

?

Homework 5

Assessment  
overview

Total 11/12  
points:

Score: 80%

Question

Value: 1

History: 1  
1  
1

Awarded points: 3/3

Report an error in  
this question

Previous  
question

Next question

Attached  
files

No attached  
files

Attach a file  
Attach text

$\mathcal{S} =$

matrix (rtol=0.01, atol=1e-08)



Save & Grade

Single attempt

Save

only

Additional attempts available  
with new variants

