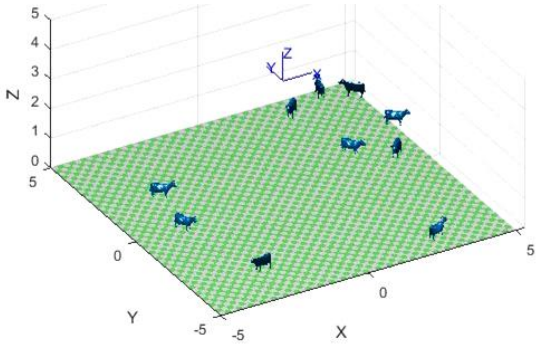
Lab 2 Exercises

1 Consider an UAV flying to monitor cattle (https://www.youtube.com/watch?v=hqVJPW7G5Rw). Use the Robot Toolbox in Matlab to animate a UAV's transforms (using tranimate) through the this path:



1.1 Start at the origin and moves up to 10m off the ground (positive Z)

1.2 Rotate (roll) around the X axis by -10 degrees so the Y axis is pointing more towards the ground than before

1.3 Move in the direction of global Y to [0,2,10]

1.4 Roll back to level (so the orientation is now eye(3))

1.5 Rotate (pitch) around the Y axis by 20 degrees so the X axis is pointing more towards the ground than before

1.6 Move in the direction of global X to [2,2,10]

1.7 Roll back to level (so the orientation is now eye(3))

1.8 Go to the ground so that the new position is [2,2,0]

1.9 Encode the steps 1.1-1.8 in a 'for' loop and use the 'fps' option in 'tranimate' to speed up the animation

1.10 Use the text tool from Week 1 Lab to plot in the left hand corner the RPY and quaternion value of the orientation at each step

2 Plotting a Herd of Moving Cows

2.1 If you don't have the modified toolbox: please download it now. It should contain RobotCows.m, the folder Ply, and a modified plot3d.m file.

2.2 Add the 'Ply' folder to your Matlab path.

2.3 Create and plot an instance of RobotCows using: `cowHerd = RobotCows();`

2.4 You can check the default cow count with: `cowHerd.cowCount`

2.5 And plot the random walk movement of them with: `cowHerd.PlotSingleRandomStep();`

2.6 Increase the number of cows, by first `close all; clear all;` then recreate a herd by passing in a new cowCount as follows: `cowHerd = RobotCows(10);`

2.7 Test many random steps

```
numSteps=100;
delay=0.01;
cowHerd.TestPlotManyStep(numSteps,delay);
```

2.8 Query the location of the 2nd cow with: `cowHerd.cow{2}.base`

3 Combine exercise 1 with exercise 2

3.1 Create a cow herd with more than 2 cows.

3.2 Plot the transform of the UAV starting at the origin (same as exercise 1)

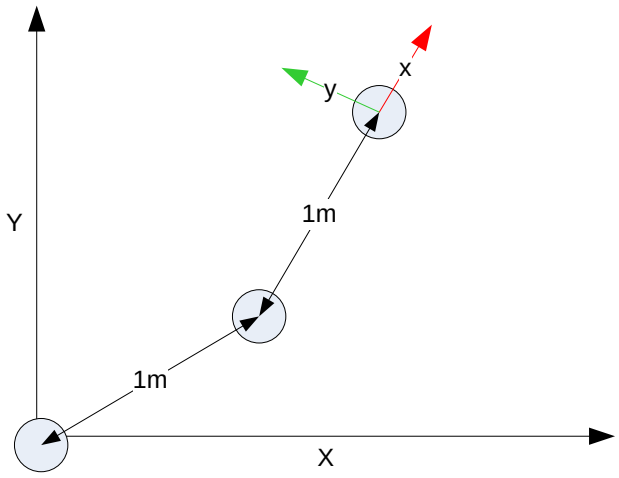
3.3 Determine the transform between the UAV and each of the cows

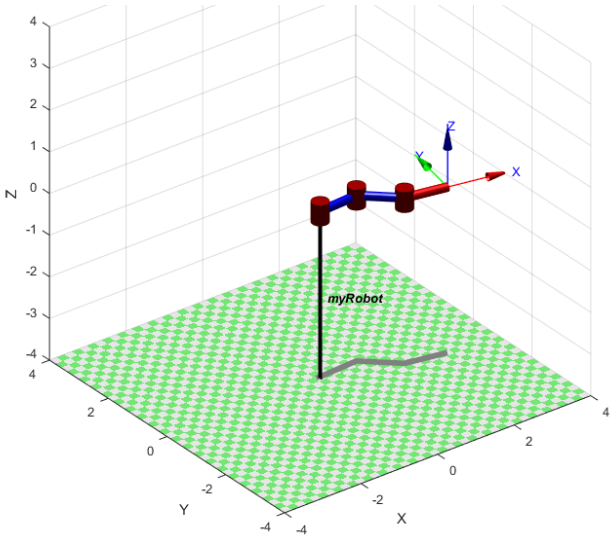
3.4 Each time the UAV moves also move the cows randomly with: `cowHerd.PlotSingleRandomStep();`

3.5 Fly through the flight path from exercise 1 and at each of the goal location determine the transform between the UAV and all the cows

3.6 Create a cow herd with 1 cow and move your drone so that at each step the cow moves stay 5 meters above it but directly overhead

4 Derive the DH parameters for the simple 3 link manipulator provided. Use these to generate a model of the manipulator using the Robot Toolbox in MATLAB.





4.1 Work out the DH Parameters.

	θ_j	d_j	a_j	α_j
Link 1	θ_1	d_1	a_1	α_1
⋮	⋮	⋮	⋮	⋮
Link n	θ_n	d_n	a_n	α_n

4.2 In MATLAB, run the Robot Toolbox, and generate the robot model. Check to see if it matches the examples provided.

```
L1 = Link('d',___,'a',___,'alpha',___,'offset',___,'qlim', [__,__]);
robot = SerialLink([L1 ... Ln],'name','myRobot');
q = zeros(1,n);    % This creates a vector of n joint angles at 0.
workspace = [-x +x -y +y -z +z];
scale = 1;
robot.plot(q,'workspace',workspace,'scale',scale);
```

4.3 You can manually play around with the robot: `robot.teach();`

4.4 Get the current joint angles based on the position in the model. `q = robot.getpos()`

4.5 Get the joint limits with `robot.qlim`