

Tutorial EECE 571R/ MECH 563/ MECH 464

Outline

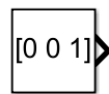
- Rotation Matrix Visualization in Simulink

Simulink: Using a Matlab Function as a Block

- Sometimes it is necessary to use a user defined block in the pipeline of Simulink. For example, if we consider the transformation of rotation matrix representation to axis angle representation, we can use a matlab function to do the transformation. We will be showing a simple example of how to measure the axis-angle representation from the rotation matrix.

Axis Angle to Rotation Matrix: Step 1

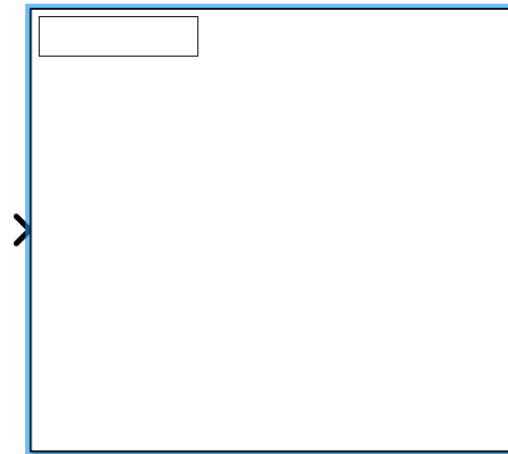
- Start a new Simulink model and drag two constant blocks for inputs and one display block to show the rotation matrix.



Axis



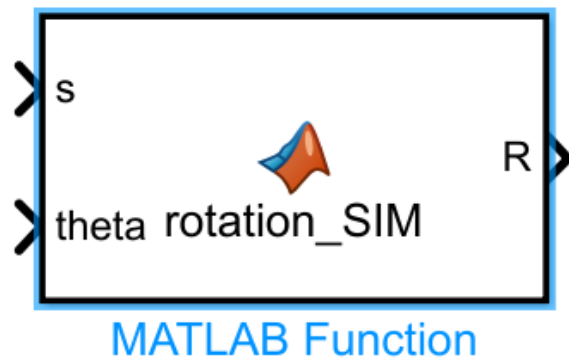
Angle



Rotation Matrix

Axis Angle to Rotation Matrix: Step 2

- From the Library Browser, drag a Matlab Function block and define the transformation by double clicking the block.



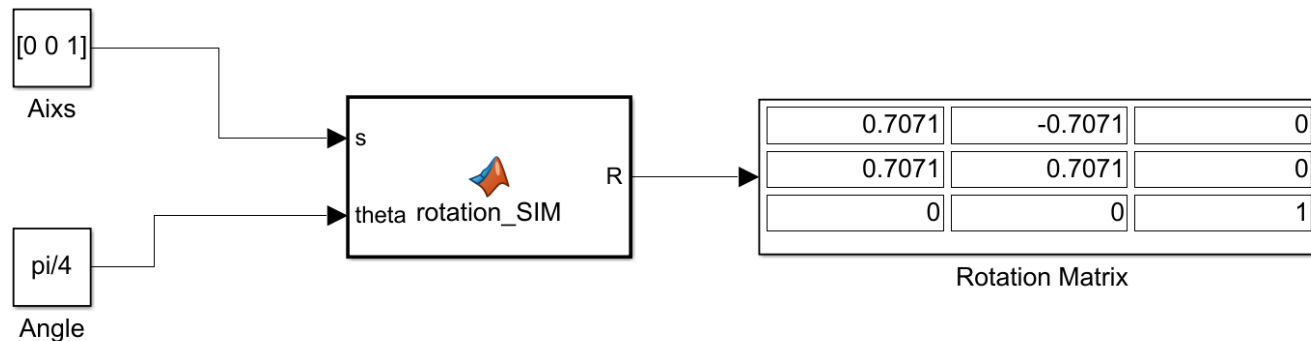
```
function R = rotation_SIM(s,theta)

    sx=[0 -s(3) s(2);
        s(3) 0 -s(1);
        -s(2) s(1) 0];
    R=expm(sx*theta);

end
```

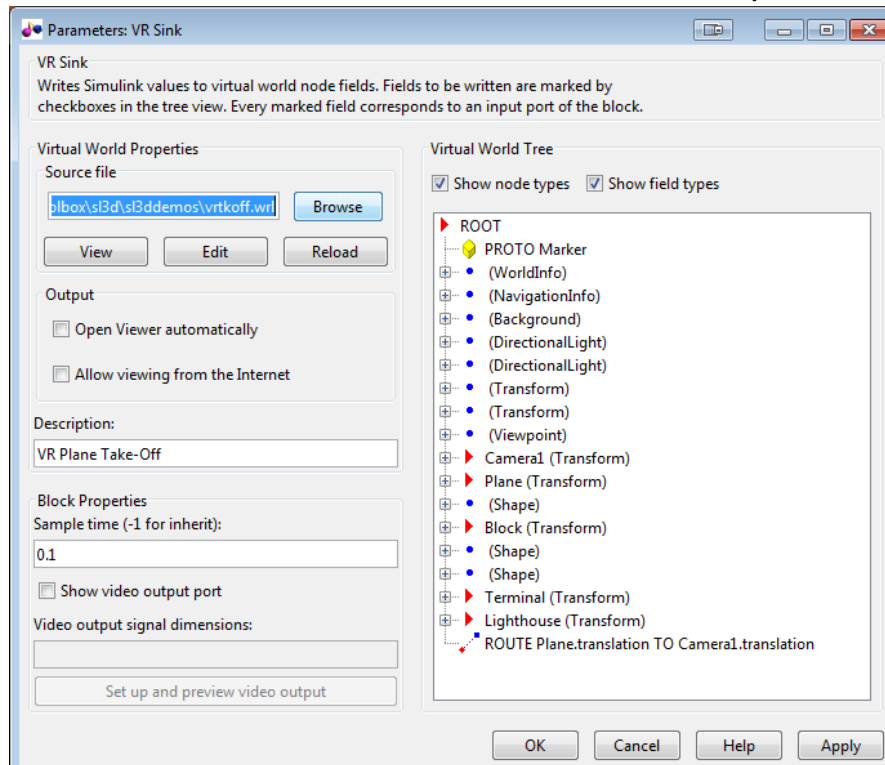
Axis Angle to Rotation Matrix: Step 3

- Connect the ports and run the model and check whether the results are correct or not. Try to play with different value of axis and angle.



Interacting with Virtual Model: Step 1

- Start with the previous model. From the library browser, drag a block called 'VR Sink'. Double click the block and select the source as \$MATLAB Rootfolder\$\toolbox\sl3d\sl3ddemos\vrtkoff.wrl. You can also use the HalfScara.wrl model, which is provided in CANVAS.

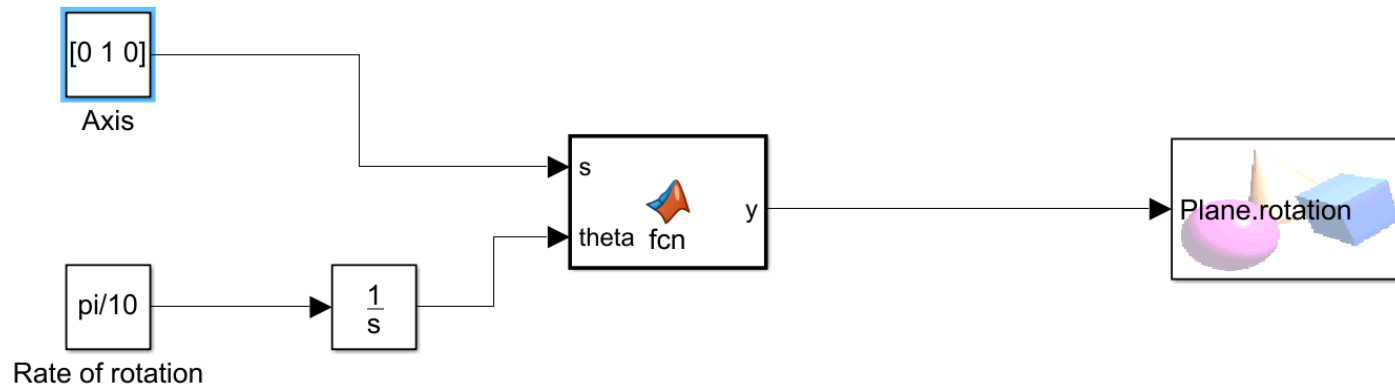


You will get a Virtual world Tree showing lot of properties. Select Plane-> Rotation. This will allow to rotate the plane with an axis and angle.

Interacting with Virtual Model: Step 2

- As a convention, virtual model takes the rotation as a 4x1 vector, where the first three components represent the axis and the last component is the angle. As we are going to rotate the plane, we will take the rate of rotation as input rather than the angle. To get the angle from the rate of rotation, we are going to use the integration block in Simulink.

Interacting with Virtual Model: Step 3



```
- function y = fcn(s, theta)
    y=[s(:); theta];
end
```

Run the model and it should show the plane is rotating around the given axis. Try to find the axis of roll, yaw and pitch of the rotation.

Interacting with Virtual Model: HalfScara

- In the HalfScara model, the first transform, the Worldtransform, is there to allow a change in base orientation once a model is built.
- Link 0 is the child of this transform, so it will move, along with everything else, with parameters such as translation of orientation that may be given in the first transform (try it!).
- Link 1 and 2 of this model are each made up of five building blocks (four boxes and a cylinder).
- Link 1 is a child of the Worldtransform (it could have been made a child of Link 0), Link 2 a child of Link 1.
- I have selected the rotation of Link 1 and rotation of Link 2, to show how the robot will move.

Using the HalfScara Model

