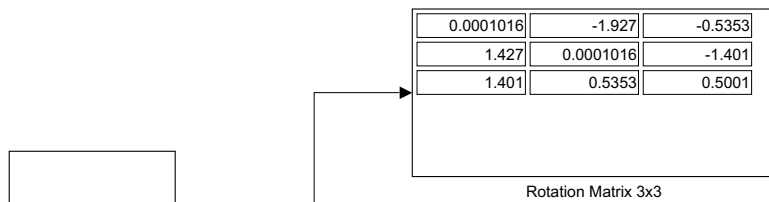*See attached .m MATLAB script to run Simulink Model*

0.0001016	-1.927	-0.5353
1.427	0.0001016	-1.401
1.401	0.5353	0.5001

Rotation Matrix 3x3

R

Block 1: Attitude to Rotation Matrix

alpha

104.5

Rotation Angle

R

a_hat

-1
1
-1.732

Axis of Rotation

Block 2: Rotation Matrix to Attitude

R
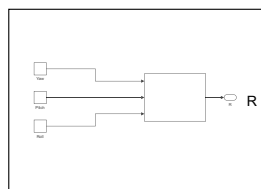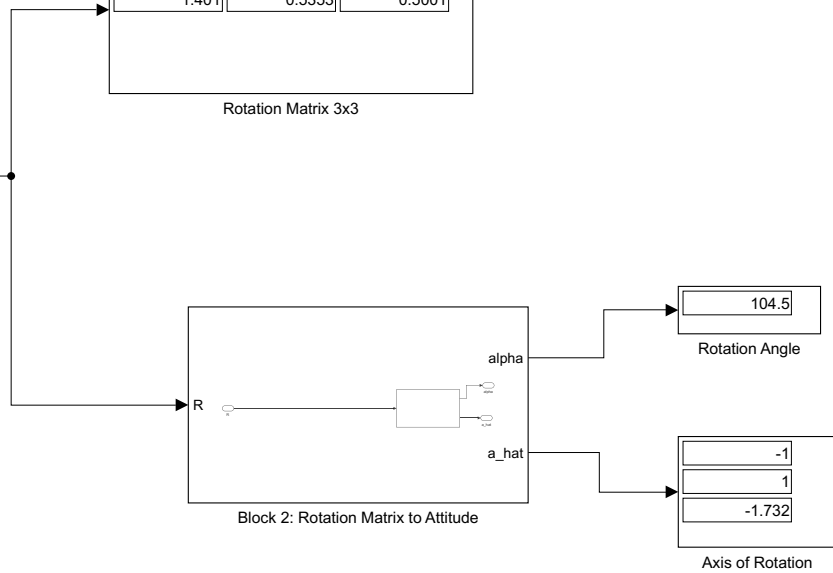
Block 3: Yaw, Pitch, and Roll to Rotation Matrix

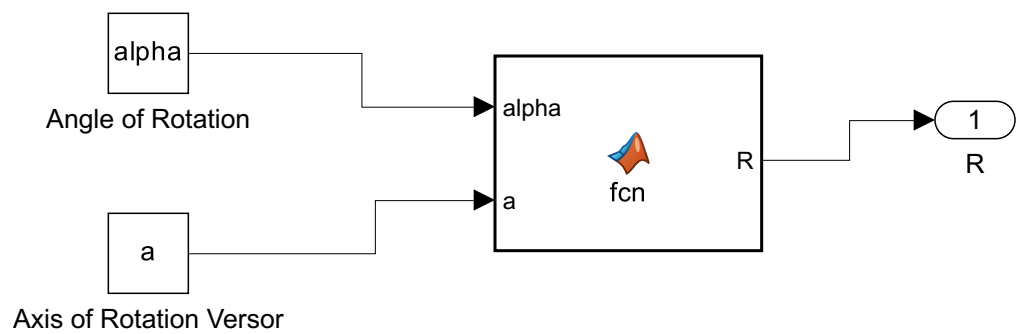| 0	0.5	0.866
-1	0	0
0	-0.866	0.5

R 3x3

psi

90

Yaw

R

theta

-60

Pitch

phi

0
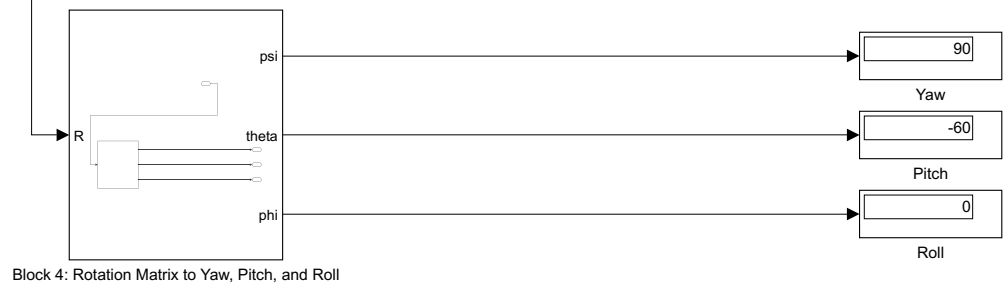
Roll

Block 4: Rotation Matrix to Yaw, Pitch, and Roll

alpha

Angle of Rotation

a

Axis of Rotation Versor

alpha

a

fcn

R

1

R

```
function R  = fcn(alpha, a)

a_hat = a/norm(a);               % Normalize vector a
a_hat_transpose = a_hat';        % Transpose Vector a
a_skew_symmetric = [0 -a(3) a(2); a(3) 0 -a(1); -a(2) a(1) 0]; % Skew Symmetric Matrix of a
I = eye(3);                      % Identity Matrix

R = cosd(alpha)*I + (1-cosd(alpha))*(a_hat*a_hat_transpose) - sind(alpha)*a_skew_symmetric; % Euler'


end
```

1
R

R

fcn

alpha

a_hat

1
alpha

2
a_hat

```matlab
function [alpha, a_hat] = fcn(R)

% Initialize alpha and a_hat
alpha = acosd((1/2)*(R(1,1) + R(2,2) + R(3,3) - 1));


a_hat = [1; 0; 0];

if alpha == 0
    a_hat = [1; 0; 0];
elseif alpha == 180
    if R(1,1) ~= -1
        a_hat_x = abs(sqrt((R(1,1) + 1) / 2));
        a_hat = [a_hat_x; R(1,2) / (2 * a_hat_x); R(1,3) / (2 * a_hat_x)];
    elseif R(2,2) ~= -1
        a_hat_y = abs(sqrt((R(2,2) + 1) / 2));
        a_hat = [R(2,1) / (2 * a_hat_y); a_hat_y; R(2,3) / (2 * a_hat_y)];
    elseif R(3,3) ~= -1
        a_hat_z = abs(sqrt((R(3,3) + 1) / 2));
        a_hat = [R(3,1) / (2 * a_hat_z); R(3,2) / (2 * a_hat_z); a_hat_z];
    end
elseif alpha > 0 && alpha < 180
    a_hat = (1 / (2 * sind(alpha))) * [R(2,3) - R(3,2); R(3,1) - R(1,3); R(1,2) - R(2,1)];
end

end
```
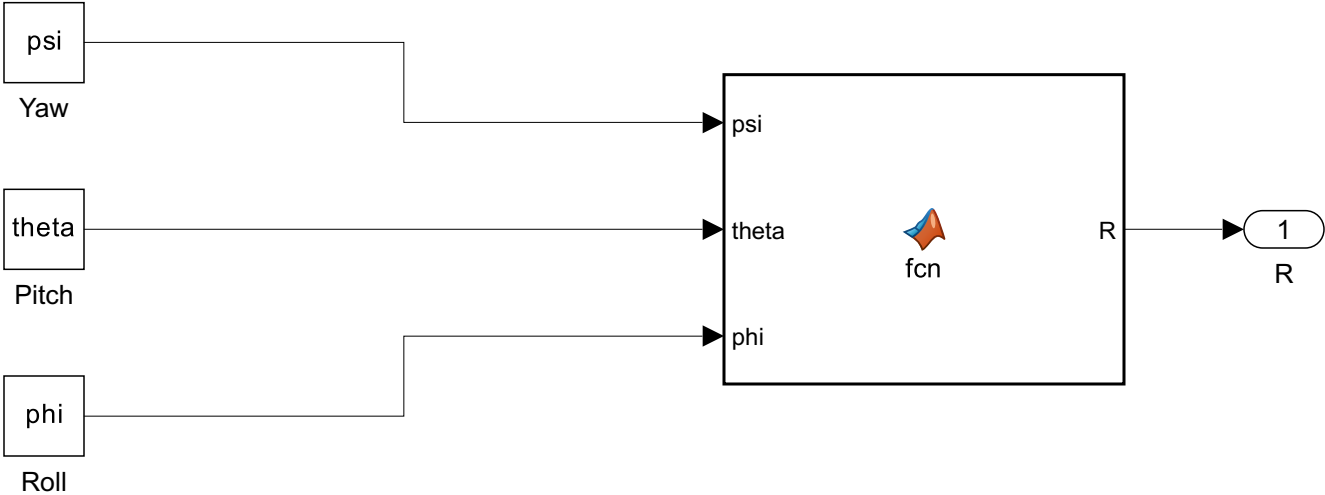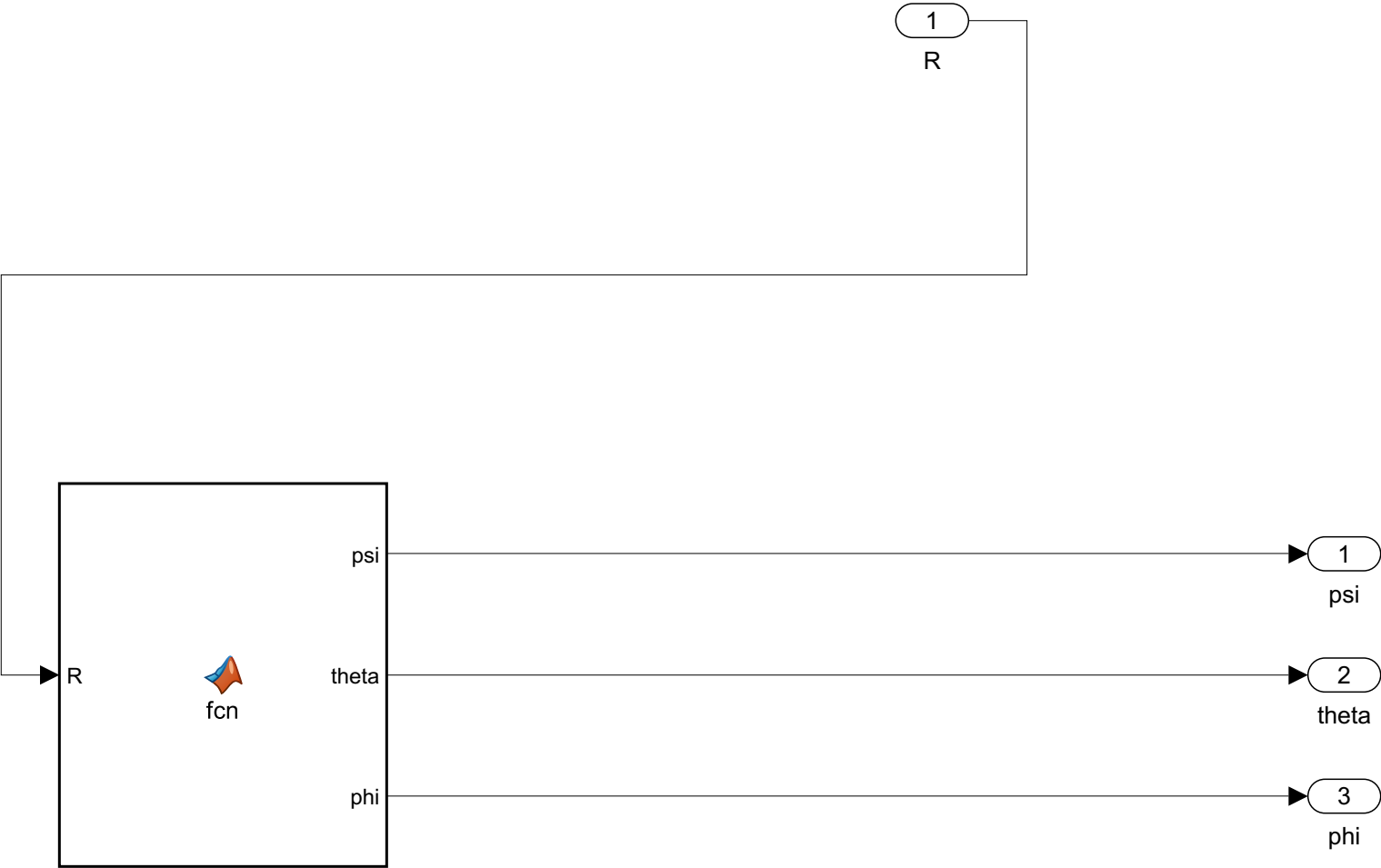
```matlab
function R  = fcn(psi,theta, phi)

R1 = [ 1 0 0  ; 0 cosd(phi) sind(phi) ; 0 -sind(phi) cosd(phi)];
R2 = [cosd(theta) 0 -sind(theta); 0 1 0; sind(theta) 0 cosd(theta)];
R3 = [ cosd(psi) sind(psi) 0 ; -sind(psi) cosd(psi) 0 ; 0 0 1];

R = R1*R2*R3

end
```

1
R

R

psi

theta

fcn

phi

1
psi

2
theta

3
phi

```
function [psi,theta,phi] = fcn(R)

phi   = atan2d(R(2,3) , R(3,3))   % Yaw
theta = asind(-R(1,3))            % Pitch
psi   = atan2d(R(1,2),R(1,1))     % Roll

end
```