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MAE562 Final Exam Problem 4

```
clear
clc

B_V      = [100 10 -10]';           % Intertial velocity expressed in body frame
B_w      = [0.1 0 0.1]';           % Angular velocity of B wrt I expressed in body frame
r        = [30 20 -120]';           % Position vector expressed in inertial frame
```

3-2-1 Euler Angle

```
psi      = 5;                       % Rotation about 3 axis [deg]
theta    = 10;                      % Rotation about 2 axis [deg]
phi      = 5;                       % Rotation about 1 axis [deg]

IcA      = [cosd(psi) -sind(psi) 0; sind(psi) cosd(psi) 0; 0 0 1];      % Rotation matrix from Inertial to first intermediate frame
AcA2     = [cosd(theta) 0 sind(theta); 0 1 0; -sind(theta) 0 cosd(theta)]; % Rotation matrix from first intermediate frame to second intermediate frame
A2cB     = [1 0 0; 0 cosd(phi) -sind(phi); 0 sind(phi) cosd(phi)];      % Rotation matrix second intermediate frame to body frame

IcB      = IcA*AcA2*A2cB;           % 3-2-1 Euler Rotation Matrix

I_V      = IcB*B_V;                 % Intertial velocity expressed in inertial frame
I_w      = IcB*B_w;                 % Angular velocity of B wrt I expressed in inertial frame
```

Spatial Velocity

```
skew_w_I = [ 0 -I_w(3) I_w(2); I_w(3) 0 -I_w(1); -I_w(2) I_w(1) 0]; % Skew symmetric matrix of angular velocity of B wrt I expressed in inertial frame

I_V_B    = [skew_w_I, -cross(I_w,r)+I_V; zeros(1,4)];                % Spatial Velocity

disp('The spatial velocity matrix is: ')
disp(I_V_B)
```

```
The spatial velocity matrix is:
      0      -0.0807      0.0014      97.3731
    0.0807      0      -0.1161      2.8838
   -0.0014     0.1161      0     -28.5968
      0      0      0      0
```

