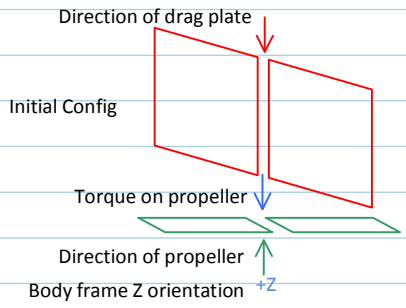
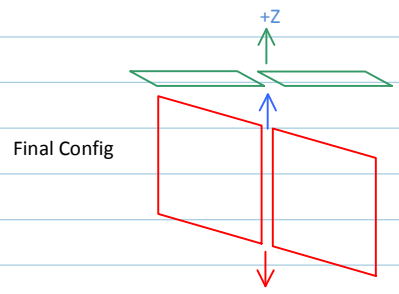
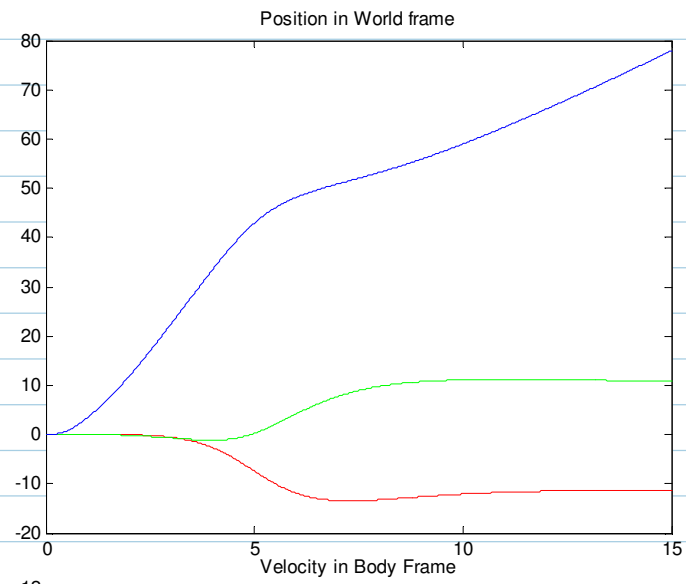
Flyer Simulator Analysis 1

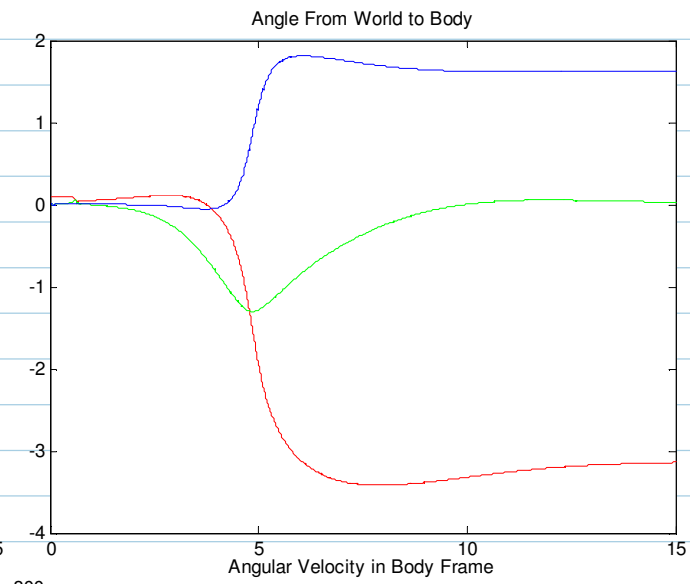
Friday, March 04, 2011
3:55 PM

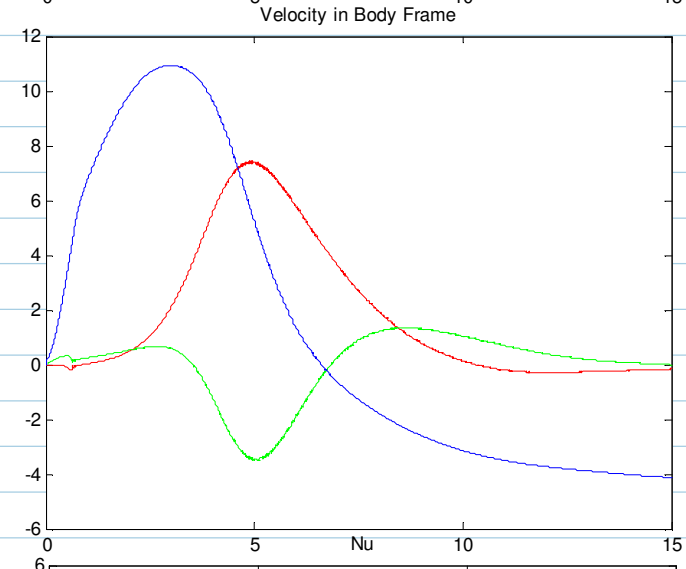


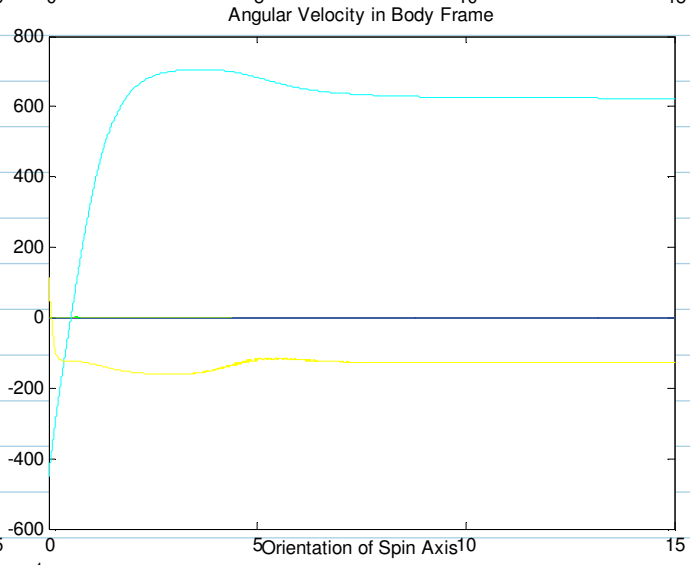


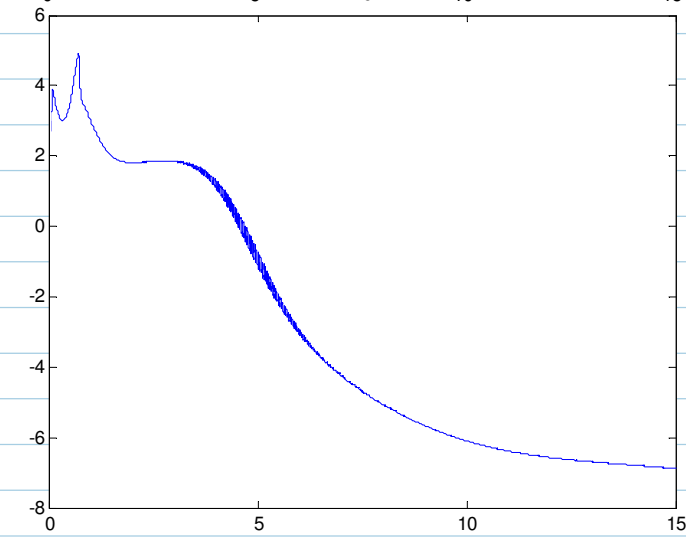

```
X = [3; 0; 0; 0; 0; 0; 0; -450; 115; .1; 0; 0; 0; 0; 0; 0; 0];
M_m = [0 0 .15]; %(Nm)

%Changable Parameters
    %Simulation properties
    drSteps = 10; %number of changes in beta and chord wrt r (1 = constant)

    %Rotor properties
    h_r = .04; %Height of rotor cg below flyer cg (cg assumed axial) (meters) (positive is down)
    m_r = .05; %rotor mass in kg
    Ir_r = [.00002,0,0;0,.00002,0;0,0,.0002]; %Rotor inertia at rotor cg in flyer frame

    %Stator properties
    h_s = -.02; %Height of stator cg below flyer cg (cg assumed axial) (meters) (positive is down)
    m_s = .1; %stator mass in kg
    Is_s = [.00001,0,0;0,.00001,0;0,0,.0001]; %Stator inertia at stator cg in flyer frame

    %Propeller properties
    h_p = .03; %Height of propeller below ROTOR cg (meters) (positive is down)
    R_p = .1; %Single blade radius (meters)
    beta_p = 0.5*ones(1,drSteps); %Propeller twist (relative to zero lift)(assumed constant) (radians)
    %beta = [? ? ? ?] to be function of r
    chord_p = .02*ones(1,drSteps); %Chord lengh (assumed constant) (meters)
    %chord =[? ? ? ?] to be function of r
    H_p = R_p; %approx height above prop that air is moved (estimated to be radius of prop)

    %Drag plate properties
    h_d = -.02; %Height of center of drag plate below stator cg (meters) (positive is down)
    R_d1 = .1; %Single plate radius (meters)
    R_d2 = .1; %Single plate radius (meters)
  %TODO::there should be 2 R_ds if drag plates are different
    beta_d = pi/2*ones(1,drSteps); %Propeller twist (relative to zero lift)(assumed constant) (radians)
    %beta = [? ? ? ?] to be function of r
    chord_d = .15*ones(1,drSteps); %Chord lengh (assumed constant) (meters)
    %chord =[? ? ? ?] to be function of r
    H_d = 0; %approx height above prop that air is moved (estimated to be zero)

    %Environment
    rho = 1.225; %air density (sea level 1.225) (kg/m^3)
    g = 9.8; %gravity acceleration (m/s^2)
```

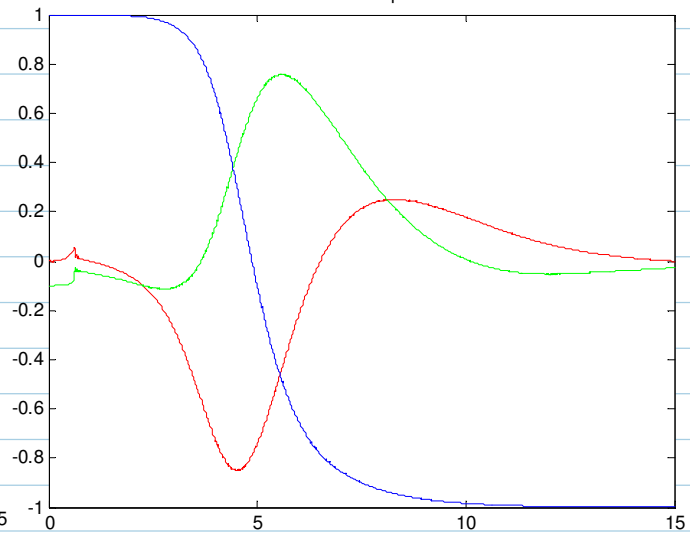












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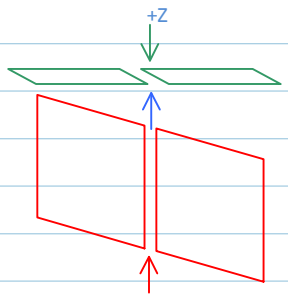
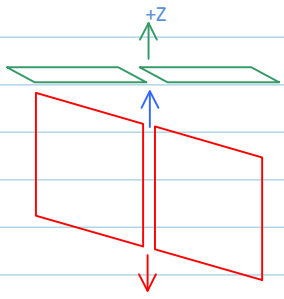
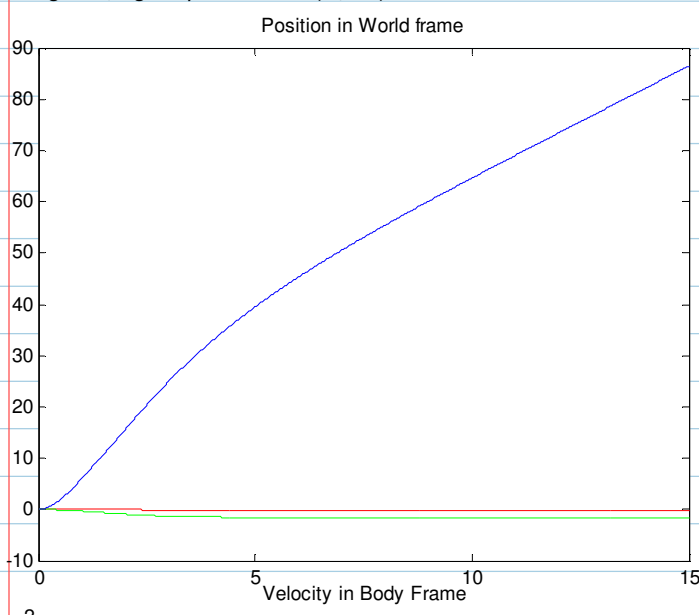
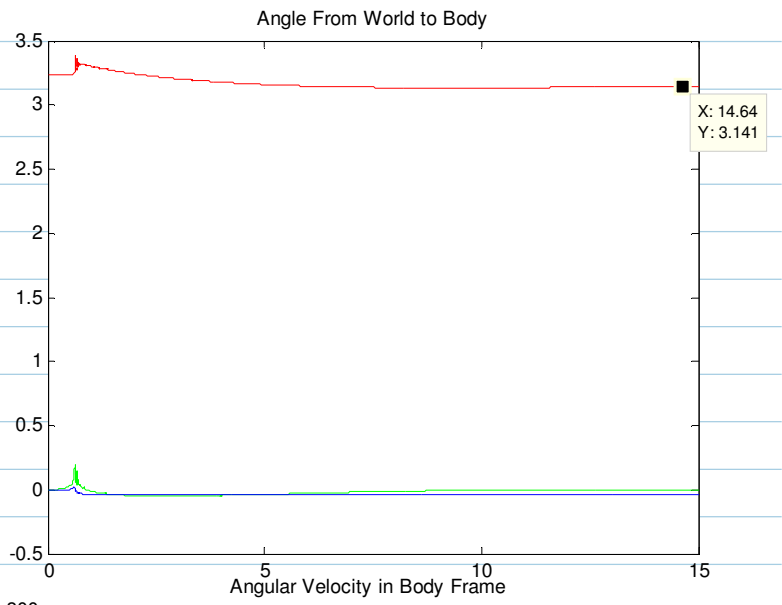


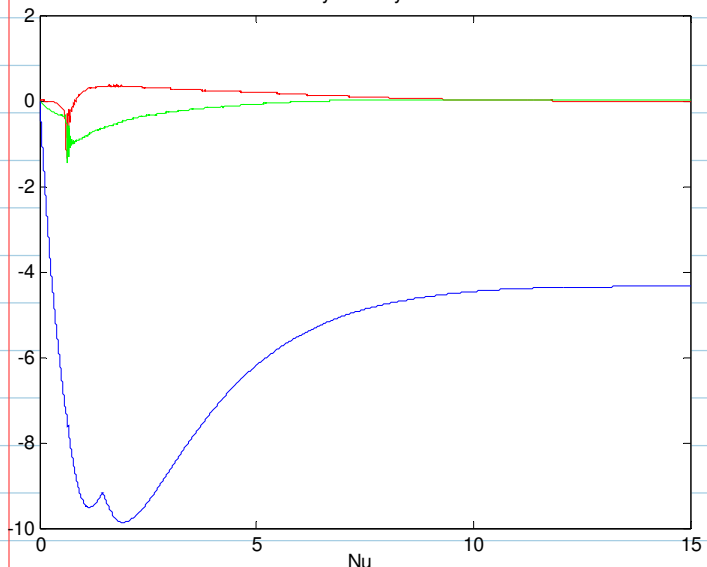

```
X = [3; 0; 0; 0; 0; 0; 0; -450; 115; 3.24; 0; 0; 0; 0; 0; 0; 0];
M_m = [0 0 .15]; %(Nm)

%Simulation properties
    drSteps = 10; %number of changes in beta and chord wrt r (1 = constant)

    %Rotor properties
    h_r = .04; %Height of rotor cg below flyer cg (cg assumed axial) (meters) (positive is down)
    m_r = .05; %rotor mass in kg
    Ir_r = [.00002,0,0;0,.00002,0;0,0,.0002]; %Rotor inertia at rotor cg in flyer frame
```

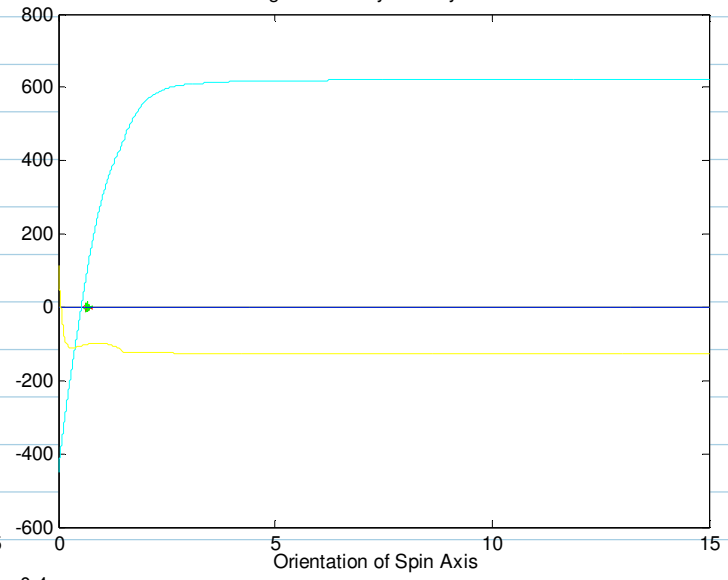


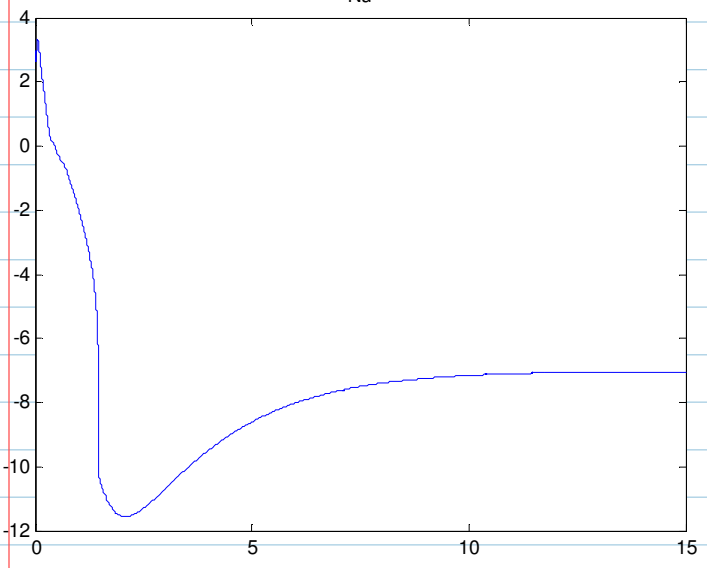

```
    %Stator properties
    h_s = -.02; %Height of stator cg below flyer cg (cg assumed axial) (meters) (positive is down)
    m_s = .1; %stator mass in kg
    Is_s = [.00001,0,0;0,.00001,0;0,0,.0001]; %Stator inertia at stator cg in flyer frame

    %Propeller properties
    h_p = .03; %Height of propeller below ROTOR cg (meters) (positive is down)
    R_p = .1; %Single blade radius (meters)
    beta_p = 0.5*ones(1,drSteps); %Propeller twist (relative to zero lift)(assumed constant) (radians)
    %beta = [? ? ? ?] to be function of r
    chord_p = .02*ones(1,drSteps); %Chord lengh (assumed constant) (meters)
    %chord =[? ? ? ?] to be function of r
    H_p = R_p; %approx height above prop that air is moved (estimated to be radius of prop)

    %Drag plate properties
    h_d = -.02; %Height of center of drag plate below stator cg (meters) (positive is down)
    R_d1 = .1; %Single plate radius (meters)
    R_d2 = .1; %Single plate radius (meters)
  %TODO::there should be 2 R_ds if drag plates are different
    beta_d = pi/2*ones(1,drSteps); %Propeller twist (relative to zero lift)(assumed constant) (radians)
    %beta = [? ? ? ?] to be function of r
    chord_d = .15*ones(1,drSteps); %Chord lengh (assumed constant) (meters)
    %chord =[? ? ? ?] to be function of r
    H_d = 0; %approx height above prop that air is moved (estimated to be zero)

    %Environment
    rho = 1.225; %air density (sea level 1.225) (kg/m^3)
    g = 9.8; %gravity acceleration (m/s^2)
```

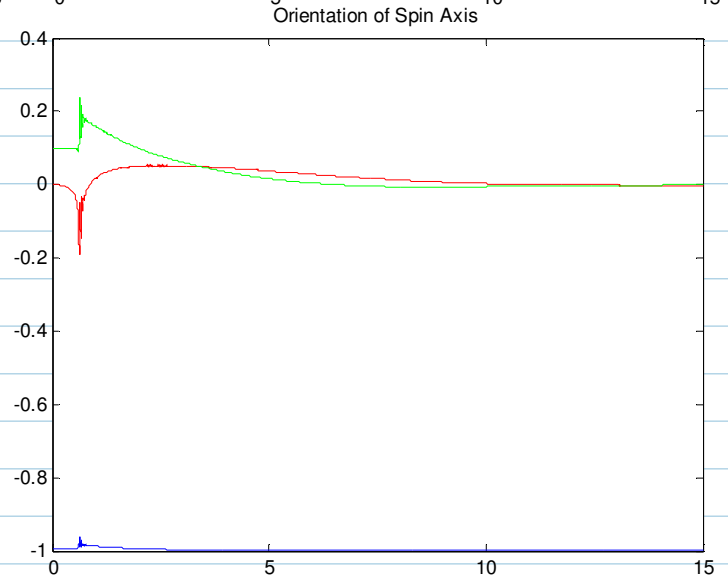












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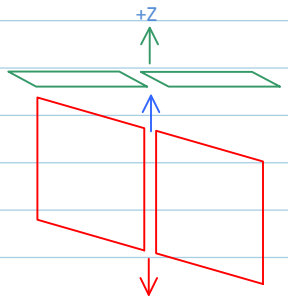
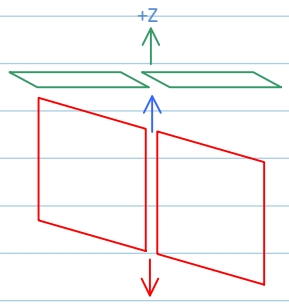
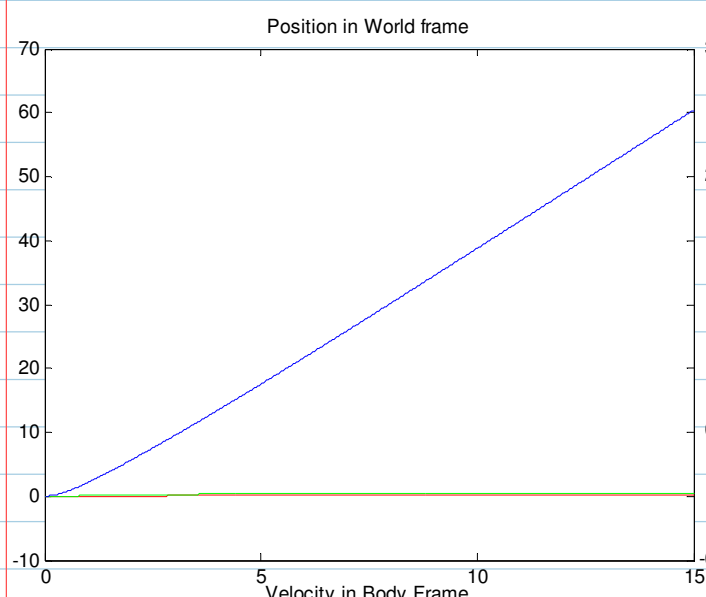
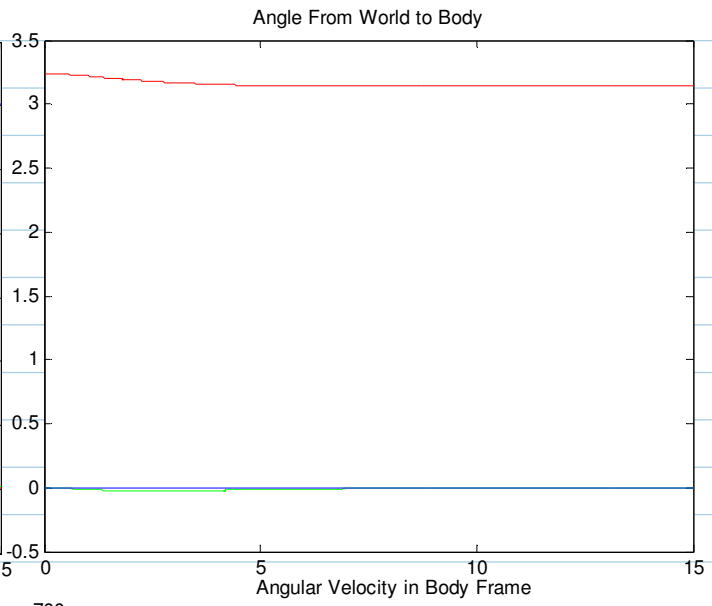


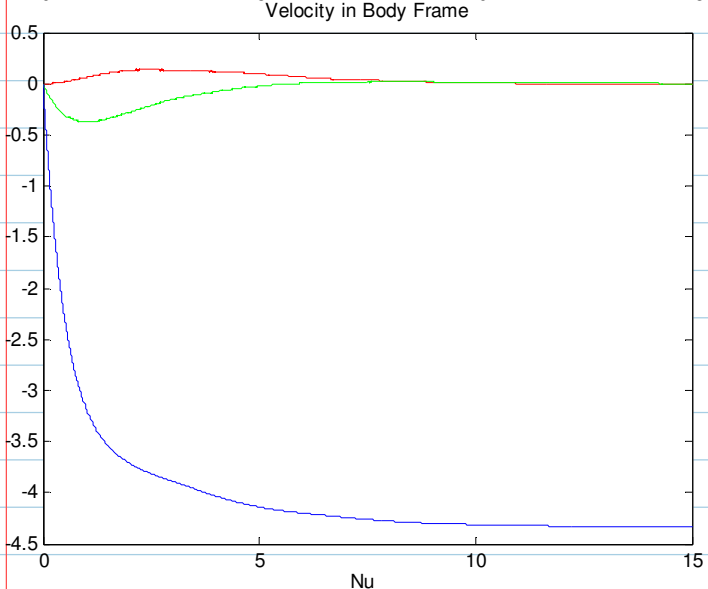

```
X = [-3; 0; 0; 0; 0; 0; 0; 450; -115; 3.24; 0; 0; 0; 0; 0; 0; 0];

M_m = [0 0 .15]; %(Nm)

%Simulation properties
    drSteps = 10; %number of changes in beta and chord wrt r (1 = constant)

    %Rotor properties
    h_r = .04; %Height of rotor cg below flyer cg (cg assumed axial) (meters) (positive is down)
    m_r = .05; %rotor mass in kg
    Ir_r = [.00002,0,0;0,.00002,0;0,0,.0002]; %Rotor inertia at rotor cg in flyer frame
```

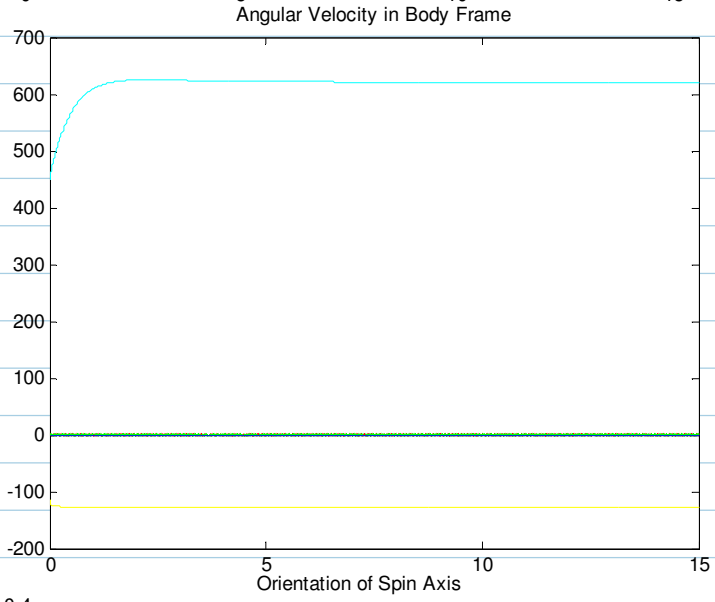


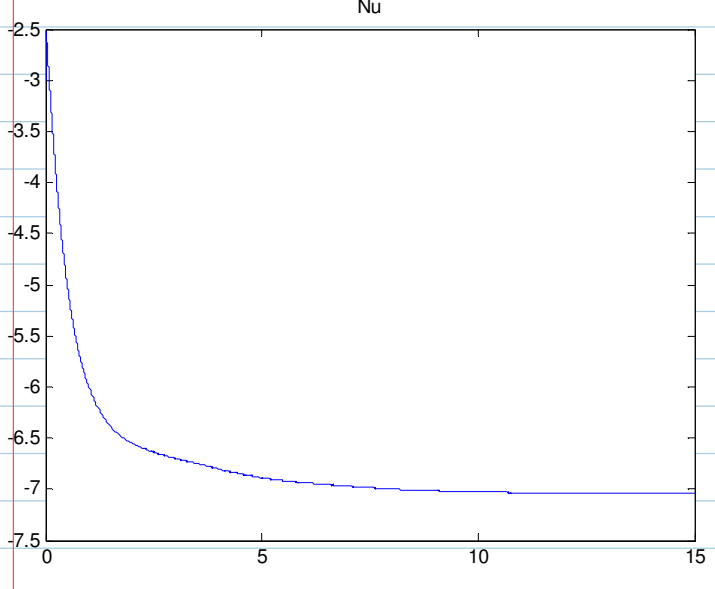

```
    %Stator properties
    h_s = -.02; %Height of stator cg below flyer cg (cg assumed axial) (meters) (positive is down)
    m_s = .1; %stator mass in kg
    Is_s = [.00001,0,0;0,.00001,0;0,0,.0001]; %Stator inertia at stator cg in flyer frame

    %Propeller properties
    h_p = .03; %Height of propeller below ROTOR cg (meters) (positive is down)
    R_p = .1; %Single blade radius (meters)
    beta_p = 0.5*ones(1,drSteps); %Propeller twist (relative to zero lift)(assumed constant) (radians)
    %beta = [? ? ? ?] to be function of r
    chord_p = .02*ones(1,drSteps); %Chord lengh (assumed constant) (meters)
    %chord =[? ? ? ?] to be function of r
    H_p = R_p; %approx height above prop that air is moved (estimated to be radius of prop)

    %Drag plate properties
    h_d = -.02; %Height of center of drag plate below stator cg (meters) (positive is down)
    R_d1 = .1; %Single plate radius (meters)
    R_d2 = .1; %Single plate radius (meters)
 %TODO::there should be 2 R_ds if drag plates are different
    beta_d = pi/2*ones(1,drSteps); %Propeller twist (relative to zero lift)(assumed constant) (radians)
    %beta = [? ? ? ?] to be function of r
    chord_d = .15*ones(1,drSteps); %Chord lengh (assumed constant) (meters)
    %chord =[? ? ? ?] to be function of r
    H_d = 0; %approx height above prop that air is moved (estimated to be zero)

    %Environment
    rho = 1.225; %air density (sea level 1.225) (kg/m^3)
    g = 9.8; %gravity acceleration (m/s^2)
```

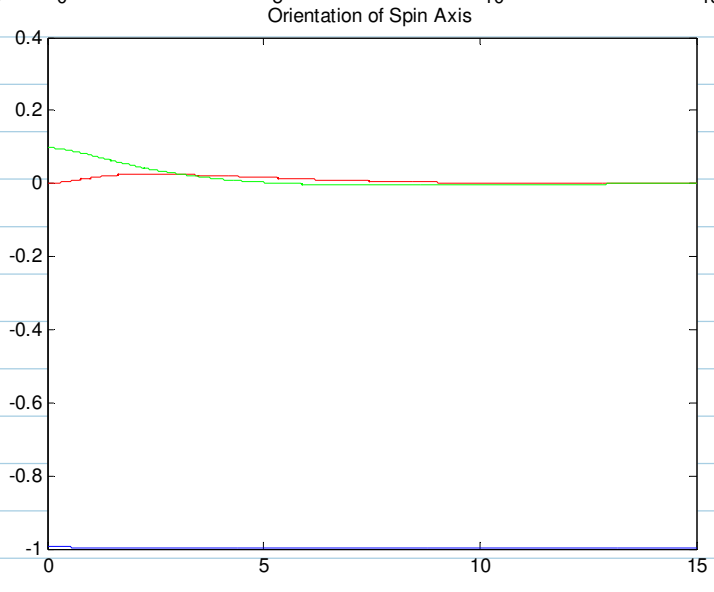












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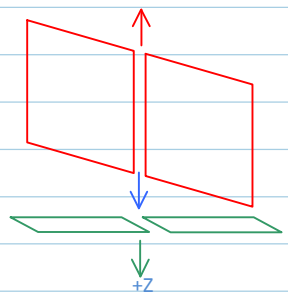
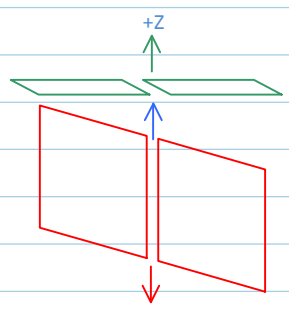
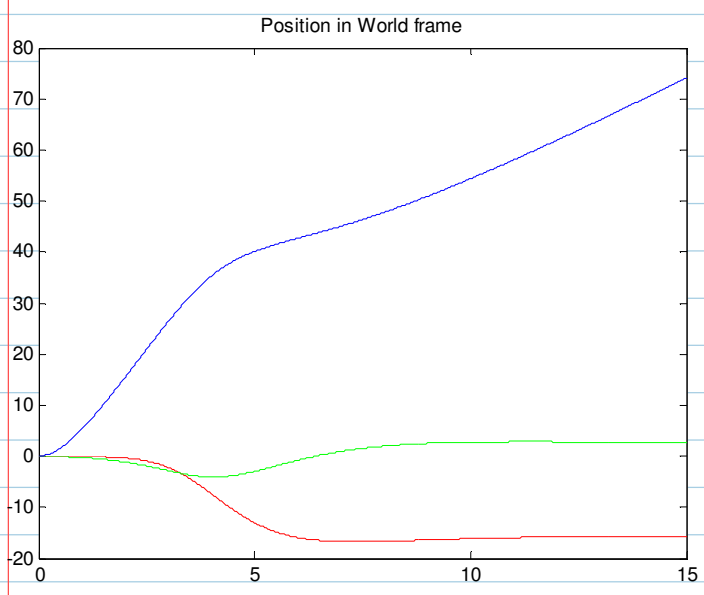
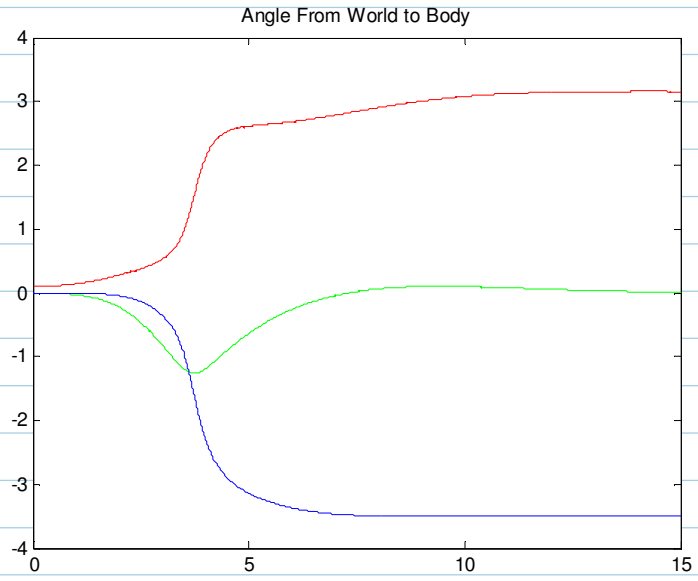


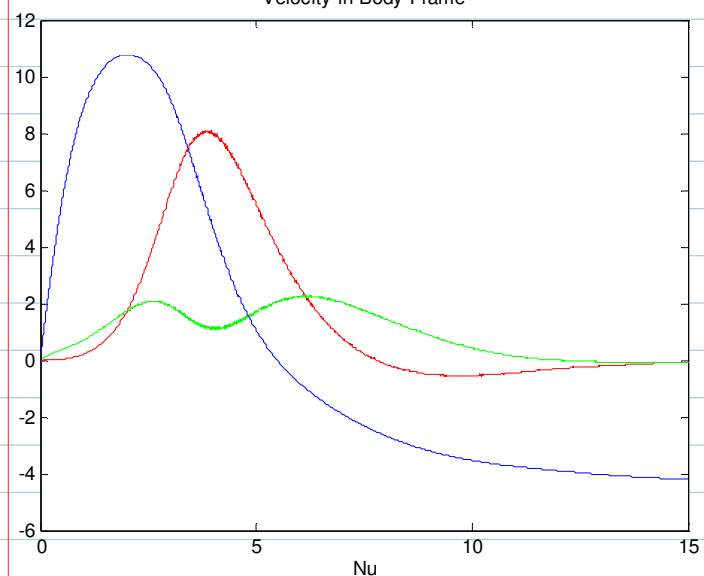

```
X = [-3; 0; 0; 0; 0; 0; 0; 450; -115; .1; 0; 0; 0; 0; 0; 0; 0];

M_m = [0 0 .15]; %(Nm)

%Simulation properties
    drSteps = 10; %number of changes in beta and chord wrt r (1 = constant)

    %Rotor properties
    h_r = .04; %Height of rotor cg below flyer cg (cg assumed axial) (meters) (positive is down)
    m_r = .05; %rotor mass in kg
    Ir_r = [.00002,0,0;0,.00002,0;0,0,.0002]; %Rotor inertia at rotor cg in flyer frame
```

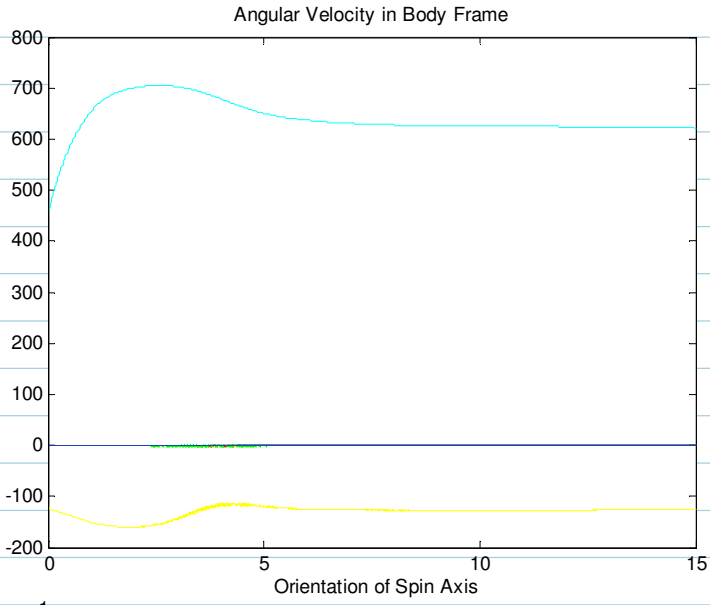


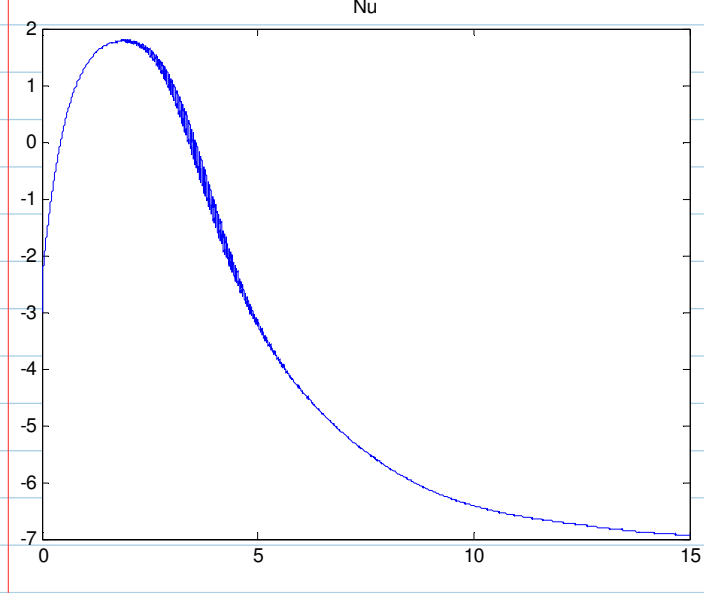

```
    %Stator properties
    h_s = -.02; %Height of stator cg below flyer cg (cg assumed axial) (meters) (positive is down)
    m_s = .1; %stator mass in kg
    Is_s = [.00001,0,0;0,.00001,0;0,0,.0001]; %Stator inertia at stator cg in flyer frame

    %Propeller properties
    h_p = .03; %Height of propeller below ROTOR cg (meters) (positive is down)
    R_p = .1; %Single blade radius (meters)
    beta_p = 0.5*ones(1,drSteps); %Propeller twist (relative to zero lift)(assumed constant) (radians)
    %beta = [? ? ? ?] to be function of r
    chord_p = .02*ones(1,drSteps); %Chord lengh (assumed constant) (meters)
    %chord =[? ? ? ?] to be function of r
    H_p = R_p; %approx height above prop that air is moved (estimated to be radius of prop)

    %Drag plate properties
    h_d = -.02; %Height of center of drag plate below stator cg (meters) (positive is down)
    R_d1 = .1; %Single plate radius (meters)
    R_d2 = .1; %Single plate radius (meters)
  %TODO::there should be 2 R_ds if drag plates are different
    beta_d = pi/2*ones(1,drSteps); %Propeller twist (relative to zero lift)(assumed constant) (radians)
    %beta = [? ? ? ?] to be function of r
    chord_d = .15*ones(1,drSteps); %Chord lengh (assumed constant) (meters)
    %chord =[? ? ? ?] to be function of r
    H_d = 0; %approx height above prop that air is moved (estimated to be zero)

    %Environment
    rho = 1.225; %air density (sea level 1.225) (kg/m^3)
    g = 9.8; %gravity acceleration (m/s^2)
```

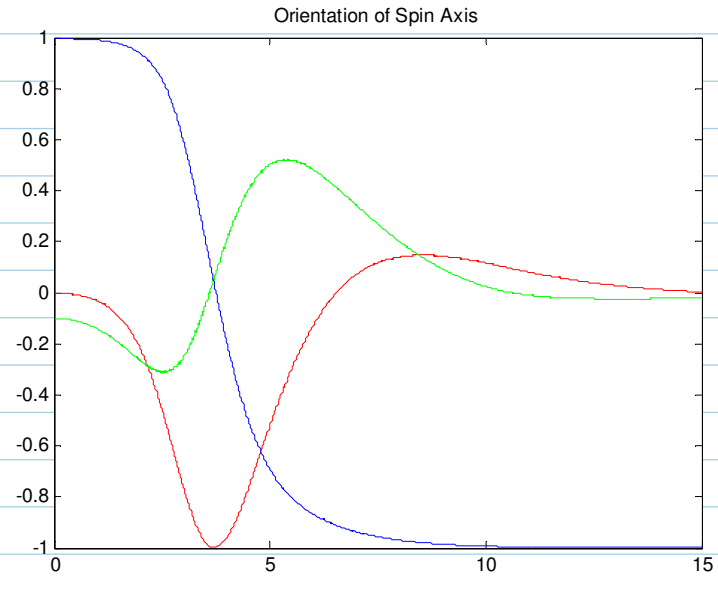












Saturday, March 05, 2011
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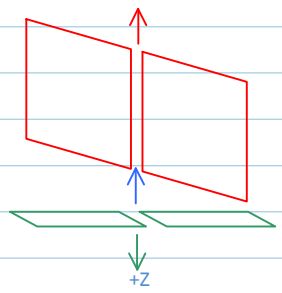
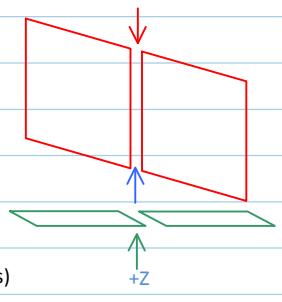
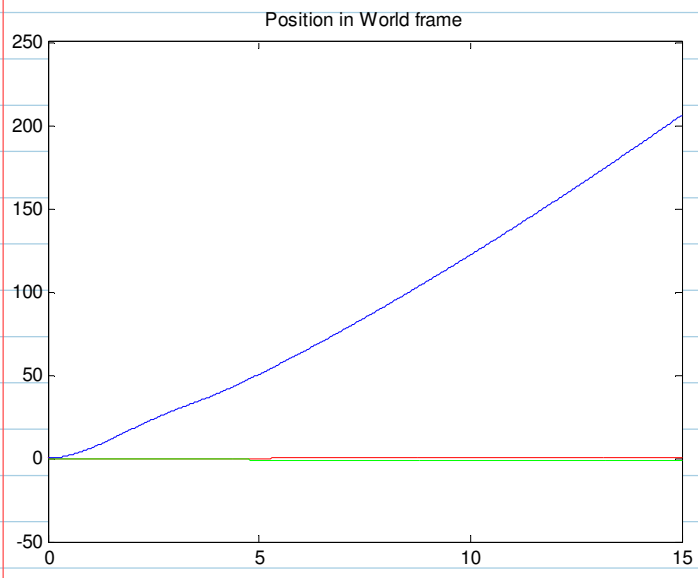
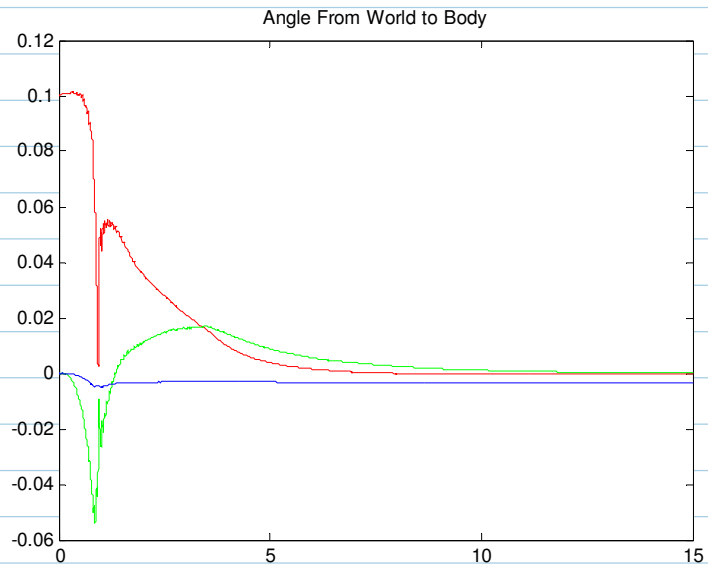
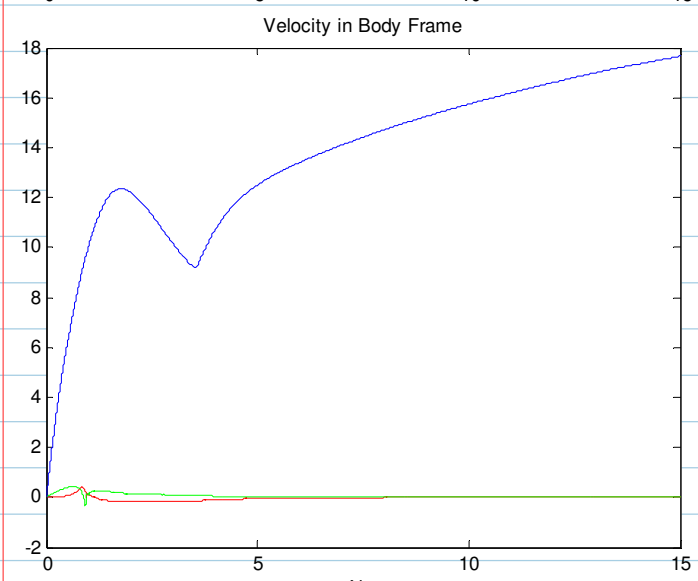


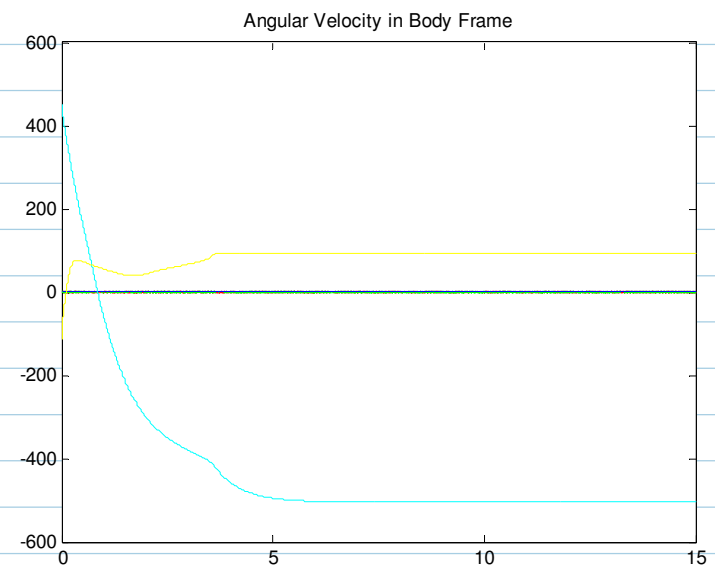

```
X = [-3; 0; 0; 0; 0; 0; 0; 450; -115; .1; 0; 0; 0; 0; 0; 0; 0];

M_m = [0 0 -.084]; %(Nm)

%Simulation properties
    drSteps = 10; %number of changes in beta and chord wrt r (1 = constant)

    %Rotor properties
    h_r = .04; %Height of rotor cg below flyer cg (cg assumed axial) (meters) (positive is down)
    m_r = .05; %rotor mass in kg
    Ir_r = [.00002,0,0;0,.00002,0;0,0,.0002]; %Rotor inertia at rotor cg in flyer frame

    %Stator properties
    h_s = -.02; %Height of stator cg below flyer cg (cg assumed axial) (meters) (positive is down)
    m_s = .1; %stator mass in kg
    Is_s = [.00001,0,0;0,.00001,0;0,0,.0001]; %Stator inertia at stator cg in flyer frame

    %Propeller properties
    h_p = .03; %Height of propeller below ROTOR cg (meters) (positive is down)
    R_p = .1; %Single blade radius (meters)
    beta_p = 0.5*ones(1,drSteps); %Propeller twist (relative to zero lift)(assumed constant) (radians)
    %beta = [? ? ? ?] to be function of r
    chord_p = .02*ones(1,drSteps); %Chord lengh (assumed constant) (meters)
    %chord =[? ? ? ?] to be function of r
    H_p = R_p; %approx height above prop that air is moved (estimated to be radius of prop)

    %Drag plate properties
    h_d = -.02; %Height of center of drag plate below stator cg (meters) (positive is down)
    R_d1 = .1; %Single plate radius (meters)
    R_d2 = .1; %Single plate radius (meters)
  %TODO::there should be 2 R_ds if drag plates are different
    beta_d = pi/2*ones(1,drSteps); %Propeller twist (relative to zero lift)(assumed constant) (radians)
    %beta = [? ? ? ?] to be function of r
    chord_d = .15*ones(1,drSteps); %Chord lengh (assumed constant) (meters)
    %chord =[? ? ? ?] to be function of r
    H_d = 0; %approx height above prop that air is moved (estimated to be zero)

    %Environment
    rho = 1.225; %air density (sea level 1.225) (kg/m^3)
    g = 9.8; %gravity acceleration (m/s^2)
```

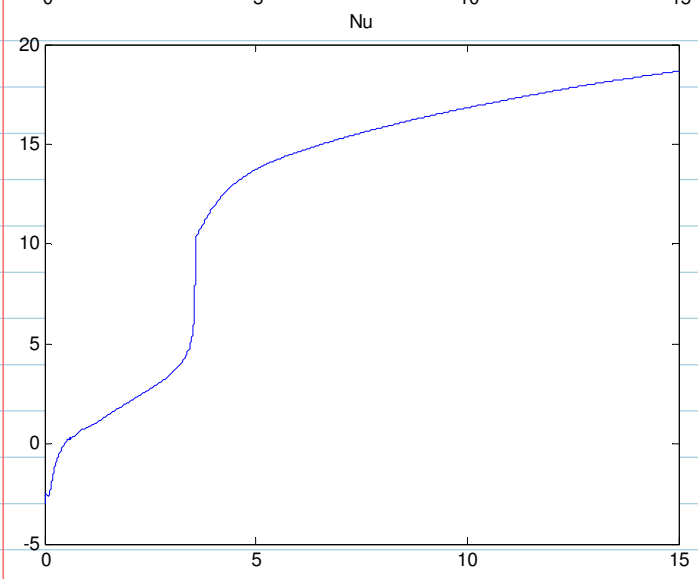


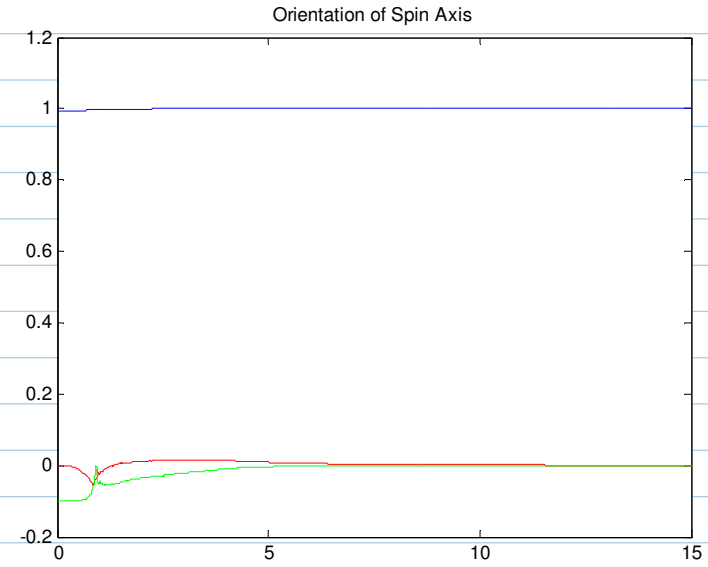












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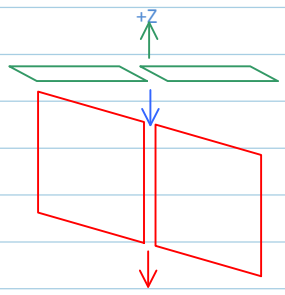
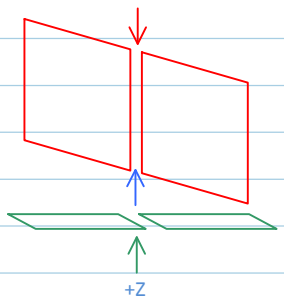
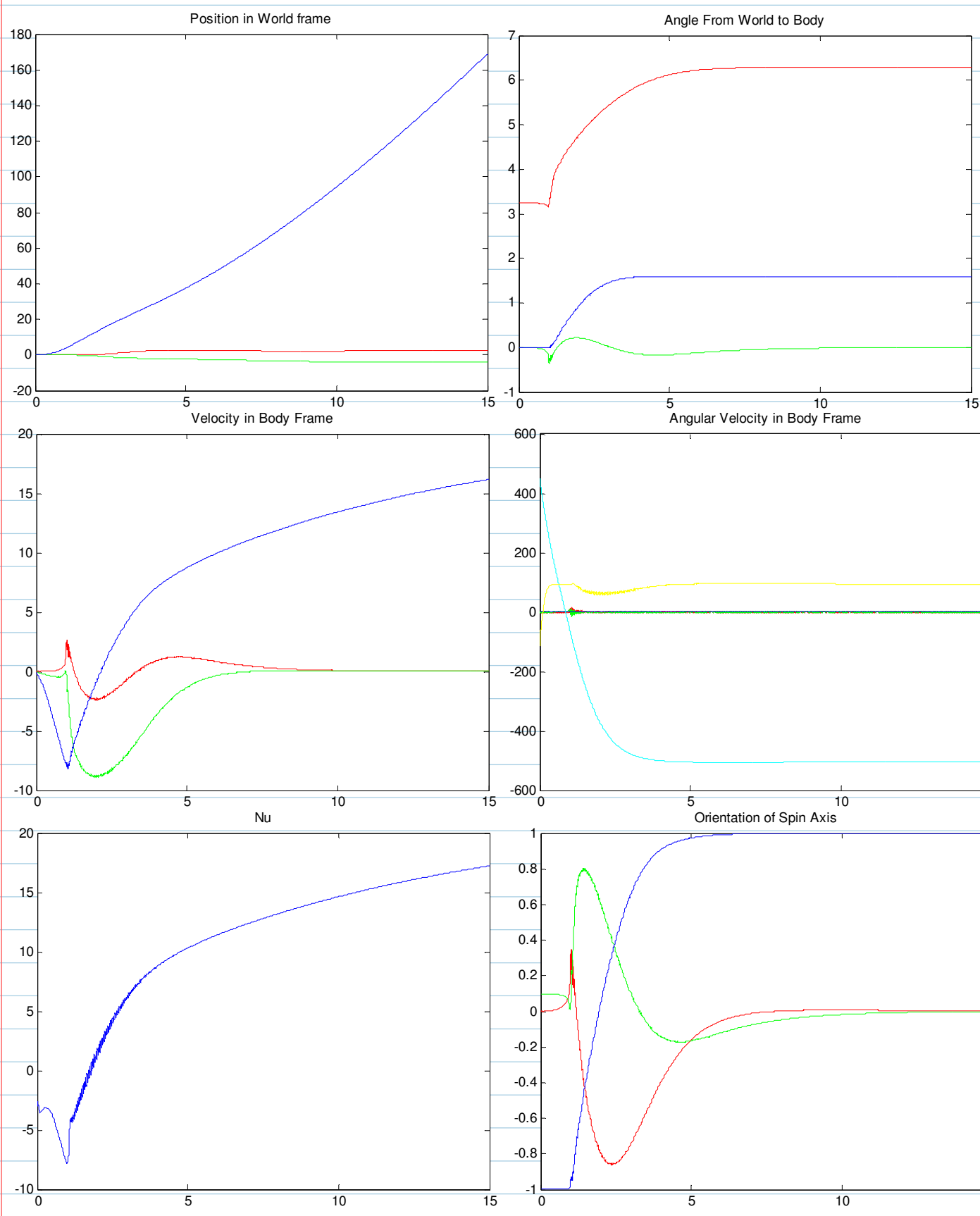



```
X = [-3; 0; 0; 0; 0; 0; 0; 450; -115; 3.24; 0; 0; 0; 0; 0; 0; 0];

M_m = [0 0 -.084]; %(Nm)

%Simulation properties
    drSteps = 10; %number of changes in beta and chord wrt r (1 = constant)

    %Rotor properties
    h_r = .04; %Height of rotor cg below flyer cg (cg assumed axial) (meters) (positive is down)
    m_r = .05; %rotor mass in kg
    Ir_r = [.00002,0,0;0,.00002,0;0,0,.0002]; %Rotor inertia at rotor cg in flyer frame

    %Stator properties
    h_s = -.02; %Height of stator cg below flyer cg (cg assumed axial) (meters) (positive is down)
    m_s = .1; %stator mass in kg
    Is_s = [.00001,0,0;0,.00001,0;0,0,.0001]; %Stator inertia at stator cg in flyer frame

    %Propeller properties
    h_p = .03; %Height of propeller below ROTOR cg (meters) (positive is down)
    R_p = .1; %Single blade radius (meters)
    beta_p = 0.5*ones(1,drSteps); %Propeller twist (relative to zero lift)(assumed constant) (radians)
    %beta = [? ? ? ?] to be function of r
    chord_p = .02*ones(1,drSteps); %Chord lengh (assumed constant) (meters)
    %chord =[? ? ? ?] to be function of r
    H_p = R_p; %approx height above prop that air is moved (estimated to be radius of prop)

    %Drag plate properties
    h_d = -.02; %Height of center of drag plate below stator cg (meters) (positive is down)
    R_d1 = .1; %Single plate radius (meters)
    R_d2 = .1; %Single plate radius (meters)
 %TODO::there should be 2 R_ds if drag plates are different
    beta_d = pi/2*ones(1,drSteps); %Propeller twist (relative to zero lift)(assumed constant) (radians)
    %beta = [? ? ? ?] to be function of r
    chord_d = .15*ones(1,drSteps); %Chord lengh (assumed constant) (meters)
    %chord =[? ? ? ?] to be function of r
    H_d = 0; %approx height above prop that air is moved (estimated to be zero)

    %Environment
    rho = 1.225; %air density (sea level 1.225) (kg/m^3)
    g = 9.8; %gravity acceleration (m/s^2)
```





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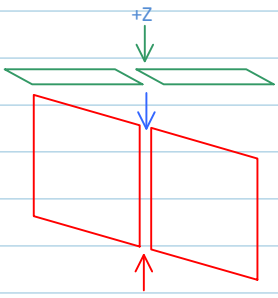
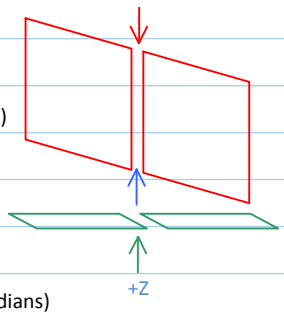
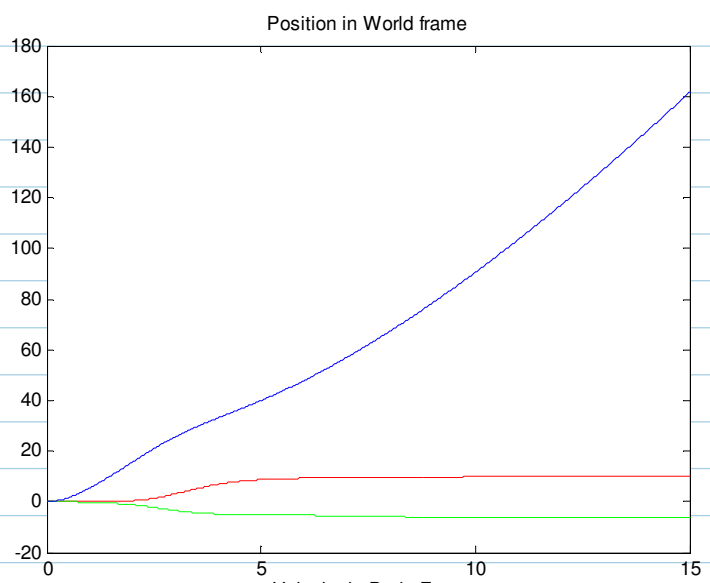
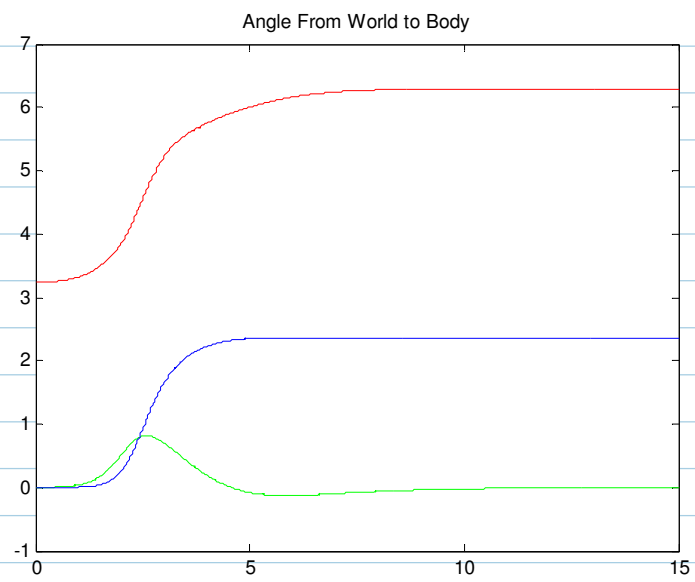
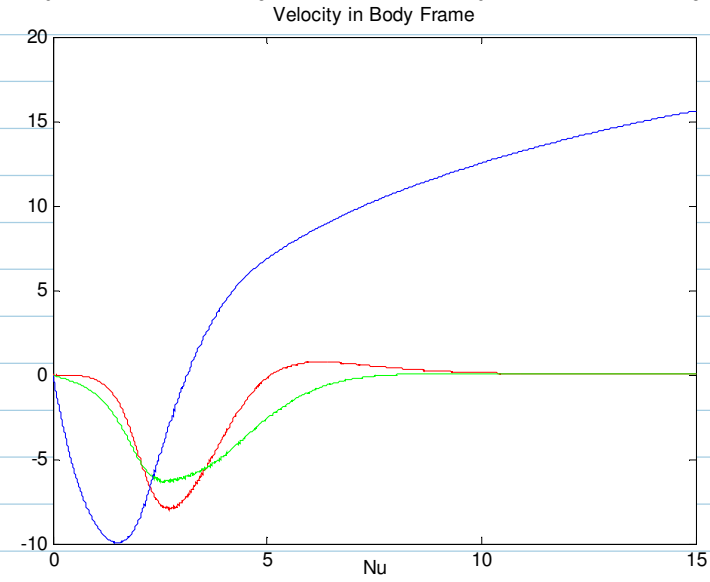


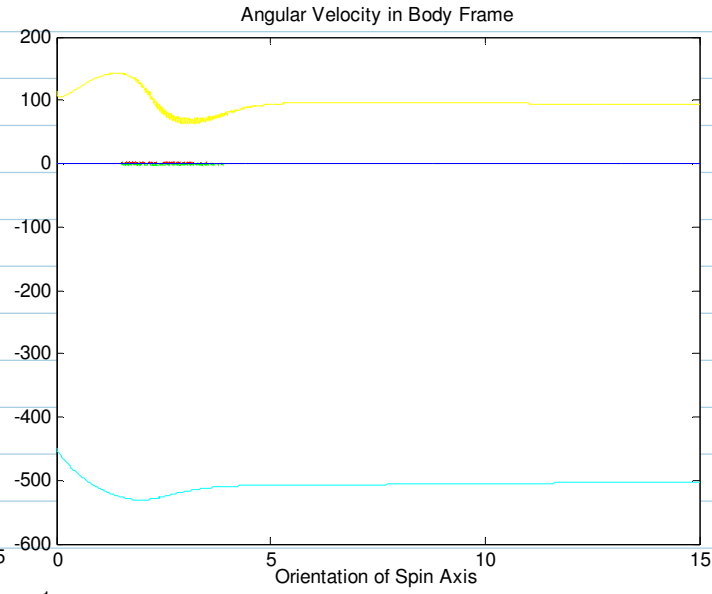

```
X = [3; 0; 0; 0; 0; 0; 0; -450; 115; 3.24; 0; 0; 0; 0; 0; 0; 0];

M_m = [0 0 -.084]; %(Nm)

%Simulation properties
    drSteps = 10; %number of changes in beta and chord wrt r (1 = constant)

    %Rotor properties
    h_r = .04; %Height of rotor cg below flyer cg (cg assumed axial) (meters) (positive is down)
    m_r = .05; %rotor mass in kg
    Ir_r = [.00002,0,0;0,.00002,0;0,0,.0002]; %Rotor inertia at rotor cg in flyer frame

    %Stator properties
    h_s = -.02; %Height of stator cg below flyer cg (cg assumed axial) (meters) (positive is down)
    m_s = .1; %stator mass in kg
    Is_s = [.00001,0,0;0,.00001,0;0,0,.0001]; %Stator inertia at stator cg in flyer frame

    %Propeller properties
    h_p = .03; %Height of propeller below ROTOR cg (meters) (positive is down)
    R_p = .1; %Single blade radius (meters)
    beta_p = 0.5*ones(1,drSteps); %Propeller twist (relative to zero lift)(assumed constant) (radians)
    %beta = [? ? ? ?] to be function of r
    chord_p = .02*ones(1,drSteps); %Chord lengh (assumed constant) (meters)
    %chord =[? ? ? ?] to be function of r
    H_p = R_p; %approx height above prop that air is moved (estimated to be radius of prop)

    %Drag plate properties
    h_d = -.02; %Height of center of drag plate below stator cg (meters) (positive is down)
    R_d1 = .1; %Single plate radius (meters)
    R_d2 = .1; %Single plate radius (meters)
  %TODO::there should be 2 R_ds if drag plates are different
    beta_d = pi/2*ones(1,drSteps); %Propeller twist (relative to zero lift)(assumed constant) (radians)
    %beta = [? ? ? ?] to be function of r
    chord_d = .15*ones(1,drSteps); %Chord lengh (assumed constant) (meters)
    %chord =[? ? ? ?] to be function of r
    H_d = 0; %approx height above prop that air is moved (estimated to be zero)

    %Environment
    rho = 1.225; %air density (sea level 1.225) (kg/m^3)
    g = 9.8; %gravity acceleration (m/s^2)
```

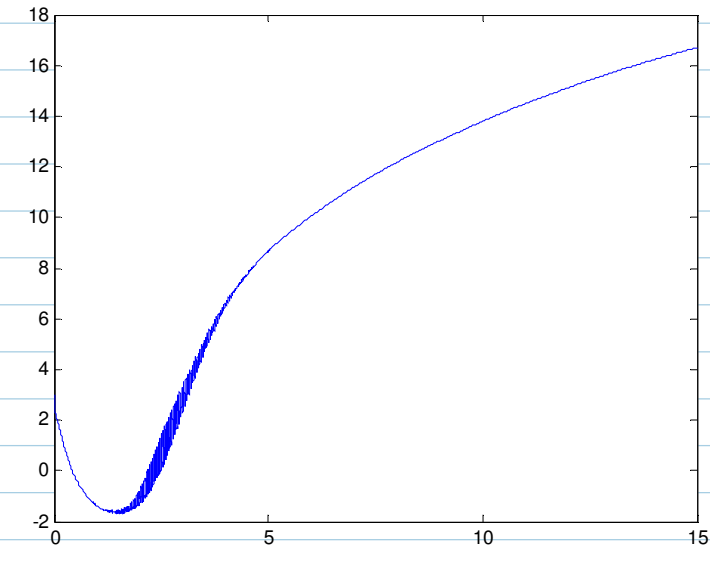


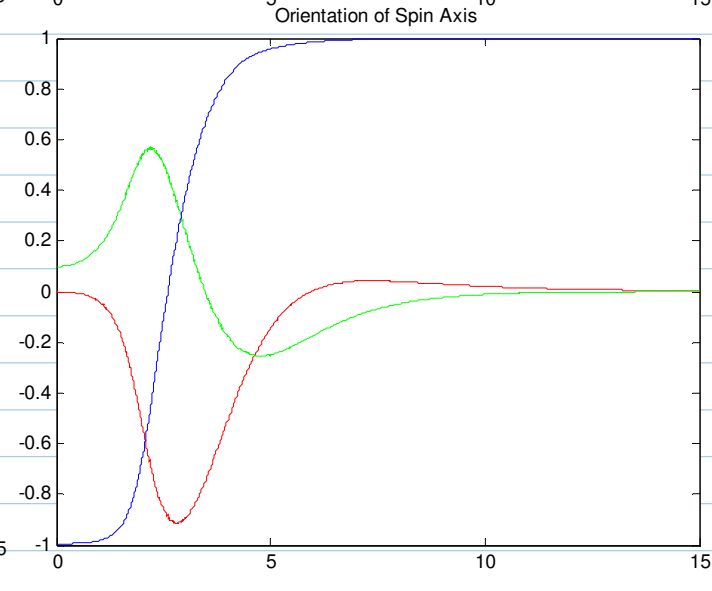












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```
X = [3; 0; 0; 0; 0; 0; 0; -450; 115; .1; 0; 0; 0; 0; 0; 0; 0];

M_m = [0 0 -.084]; %(Nm)

%Simulation properties
    drSteps = 10; %number of changes in beta and chord wrt r (1 = constant)

    %Rotor properties
    h_r = .04; %Height of rotor cg below flyer cg (cg assumed axial) (meters) (positive is down)
    m_r = .05; %rotor mass in kg
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    %Stator properties
    h_s = -.02; %Height of stator cg below flyer cg (cg assumed axial) (meters) (positive is down)
    m_s = .1; %stator mass in kg
    Is_s = [.00001,0,0;0,.00001,0;0,0,.0001]; %Stator inertia at stator cg in flyer frame

    %Propeller properties
    h_p = .03; %Height of propeller below ROTOR cg (meters) (positive is down)
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    beta_p = 0.5*ones(1,drSteps); %Propeller twist (relative to zero lift)(assumed constant) (radians)
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    %chord =[? ? ? ?] to be function of r
    H_p = R_p; %approx height above prop that air is moved (estimated to be radius of prop)

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  %TODO::there should be 2 R_ds if drag plates are different
    beta_d = pi/2*ones(1,drSteps); %Propeller twist (relative to zero lift)(assumed constant) (radians)
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    %chord =[? ? ? ?] to be function of r
    H_d = 0; %approx height above prop that air is moved (estimated to be zero)

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    rho = 1.225; %air density (sea level 1.225) (kg/m^3)
    g = 9.8; %gravity acceleration (m/s^2)
```