# Extracted Pages 4, 5, and 6 from Task\_3.pdf

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Forces:   
  
The following set of linear equations represents the change in the   
  
Aerodynamic & thrust forces & moments, they are function of:   
  
 Stability Derivatives.   
 The perturbation change in the states and the control surfaces   
  
deflections from their values at the trim condition.   
  
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Note: , , , , , are the changes in the forces & moments, i.e.   
these are not the absolute values of the forces and moments. They should be added   
to the reference values at the trim condition 0, 0, 0, 0, 0, 0 to calculate the   
absolute values , , , , , .   
  
Similarly, , , , are the changes in the states values from their values   
  
at the reference condition = 0, = 0, = 0,   
  
Hence:   
  
Inputs and outputs of the (Airframe Model) are perturbations from the reference   
values   
Inputs and outputs of the RBD are absolute values   
  
So that: Perturbation values resulting from the (Airframe Model) should   
be added to the reference values before passing them to the (RBD) and the   
  
   
   
   
   
   
   
   
  
  
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from   
absolute values   
perturbation values by subtracting the reference values from them.   
  
resulting   
  
(RBD)   
  
the   
  
should be converted   
  
to   
  
The total forces acting on an airplane are:   
  
 Aerodynamic forces.   
 Thrust force.   
 Gravity force.   
  
 mgsin = ( + )   
  
 + mgcos sin = ( + )   
  
 + mgcos cos = ( + )   
  
Equilibrium state   
  
Initially at   
  
the reference flight condition   
  
the airplane   
  
is   
  
in an   
  
equilibrium state, which means:   
  
 = 0 & = 0   
  
0 sin 0 = 0 0 = sin 0  
0 cos 0sin 0 = 0 0 = cos 0sin 0  
0 mgcos 0 cos 0 = 0 0 = mgcos 0 cos 0  
 = 0 + = + sin 0  
 = 0 + = cos 0sin 0  
 = 0 + = cos 0cos 0  
  
And the total force acting on the airplane (this value is the input which you   
will give to the RBD)   
  
 = sin = + sin 0 sin   
 = + cos sin = + cos sin   
 = + cos cos = cos 0cos 0 + cos sin   
  
   
   
   
   
   
   
   
  
  
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Types of Body axes   
  
Consult Dynamics of Flight, Bernard Etkin pages 101-103 to review the   
concept of the Body axes of the airplane and its types (principal axes, stability axes,   
body axes).   
  
You should note that the stability derivatives & Inertias of an airplane have   
different values and symbols according to the type of the body axes they are   
represented in.   
  
Very important: Study the symbols and definitions stated in (NASA CR-2144)   
appendices A&B, then use the tables of the derivatives represented in the (Body   
axes) to extract the derivatives according to your flight condition.