*(described in 18/09/17)*

*(modified on 3/10/17)*

**Non-dimensional Equations of motion are:**

(1)

Where:

All dimensional quantities are originally normalized by :

A symmetrical case is considered and it is:

\*Note: typical values that are intended to be considered are :

Equilibrium point is :

Linearizing about that equilibrium point:

…

After all calculations we can describe **the linearized equations as:**

**M**

**Where :**

The natural frequencies can be calculated from :

For the y component we get :

Other frequencies are:

It can be shown (detailed later) that , for certain parameters, we get :

For the case of , I would like to neglect by setting , where . *It will remain true for whole the rest of the problem.*

Back to the starting 3D.O.F E.O.M (1) I will isolate using the 3rd equation, in order to get and use it back in 1st two equations of x,y. and by that getting 2D.O.F dynamics to investigate asymptotically.

*The procedure is like this :*

From 3rd equation of (1) :

, where

we write it as :

**(2)**

In order to extract we **use first order approximation** :

(3)

to get:

; (4)

And **use Taylor series** (around ) for A,B :

; (5)

Where :

Setting (4,5) into (2) **and eliminating 2nd and 3rd order elements of ,** getting the relation :

*Next step is :*

Using (3) for the 1st two equations of (1) and getting new equations for a 2D.O.F problem, to asymptotically investigate :

**Non-dimensional 2D.O.F Equations of motion are:**

(7)

Where:

will be considered as result of drag on ‘CONEX’ cargo container payload. No sling cables drag will be considered :