# Exercise #2 - Eq. point

Dynamics

Although symmetry in all 3 planes can be assumed during the preliminary stages of the vehicle conceptual design, certain systems with a major importance in the vehicle mass distribution can lead to an eccentricity of the centre of gravity. Consequently, the distribution of forces (Figure 1) for the vehicle to be in equilibrium and not to pitch is not symmetrical.

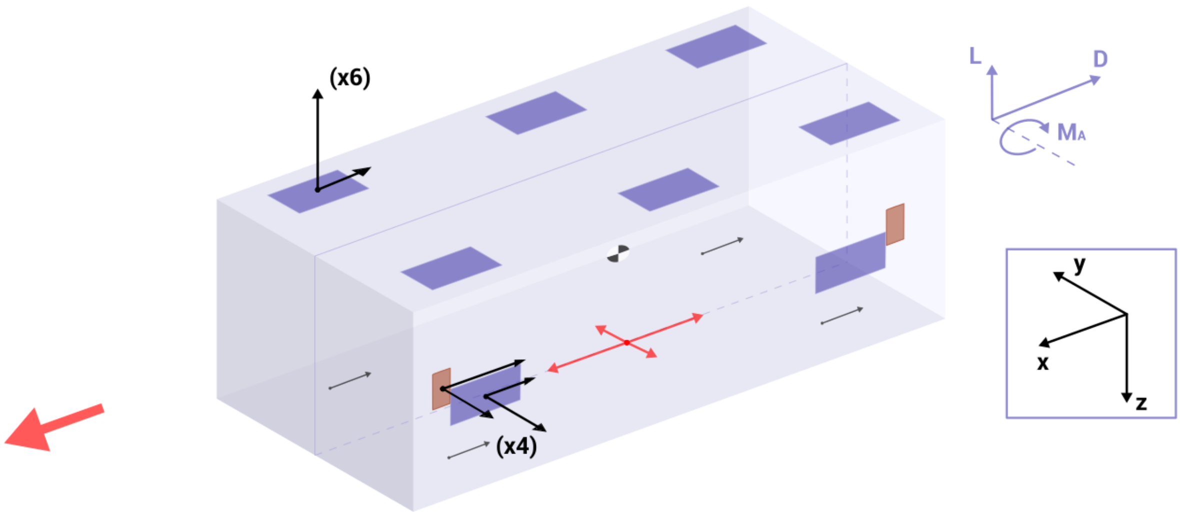


**Figure 1.** FBD.

The task is to obtain the equilibrium point of the prototype as a function of the desired nominal equilibrium air gap and the eccentricity of the centre of gravity. A schematic of the eccentricity can be seen in Figure 2.

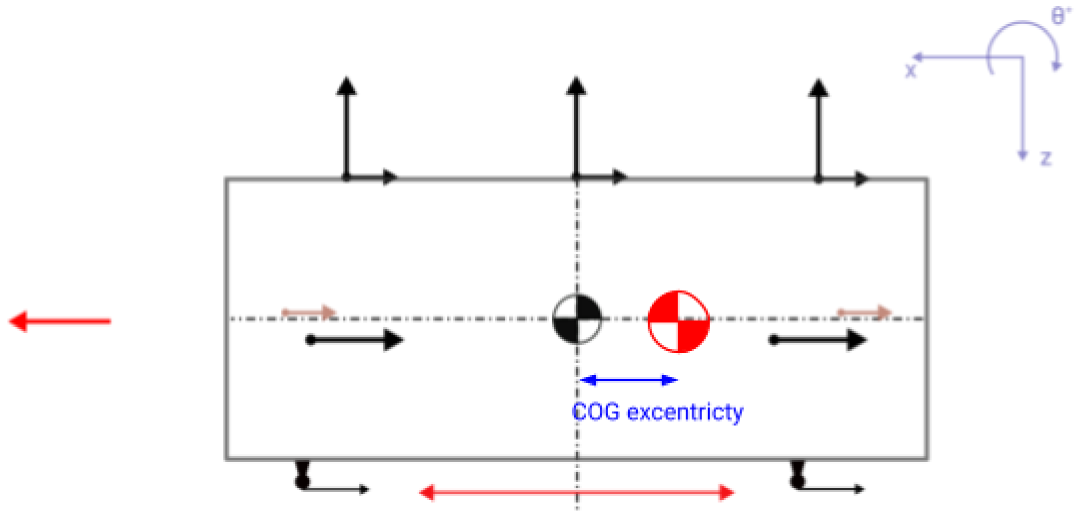


**Figure 2.** Eccentricity diagram.

It is **assumed**:

- The current in the central units is zero (***Hint #1***: however, the force of the permanent magnet must be taken into account).
- The vehicle is perfectly centred on the Y-axis, so the values sought are the currents in the front and rear levitation units (***Hint #2***: the format of the solution can be checked by *solution(numPoints, pod)*).
- The **model** of the force of the levitation units as a function of the air gap and the current **is given** in two functions stored in the *lib* folder:
    - *HEMSlev( )* → ***Hint #3***: The proposed solution uses this.
    - *HEMSsimplificado( )*
- ***Hint #4***: Newton's second law
- The prototype is in equilibrium (levitating in static conditions with a constant air gap).

The following is **required**:

1. Calculate the current to be applied to the front and rear units to bring the prototype into such an equilibrium for given values of centre of gravity eccentricity and nominal air gap:
    a. eccentricity = 0.02 m
    b. airgap = 17.5 mm

2. Plot (and save the matrices) the evolution of these currents as a function of eccentricity (see ***Hint 2***).