Mini-airship dedicated to stage recording

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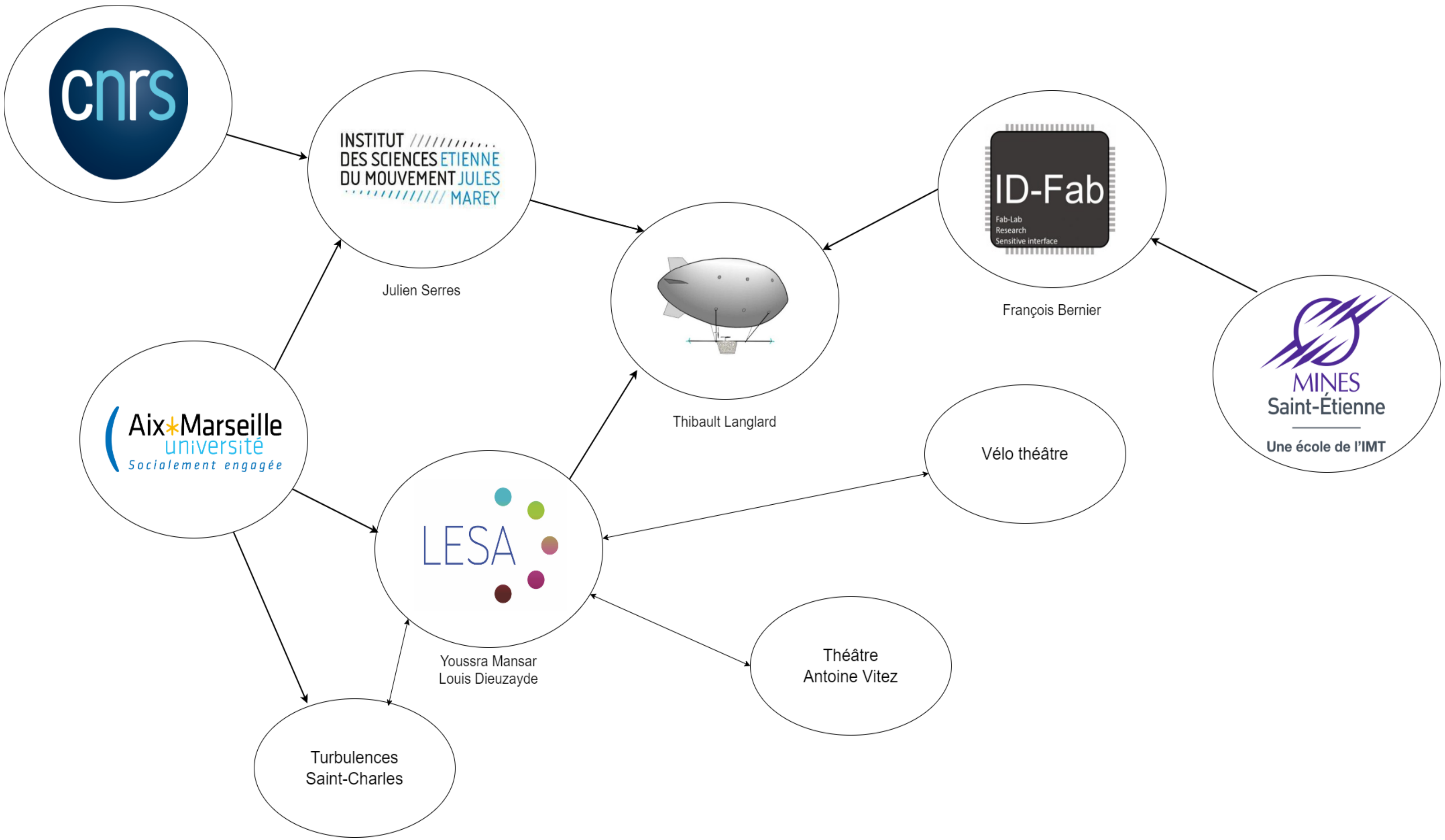

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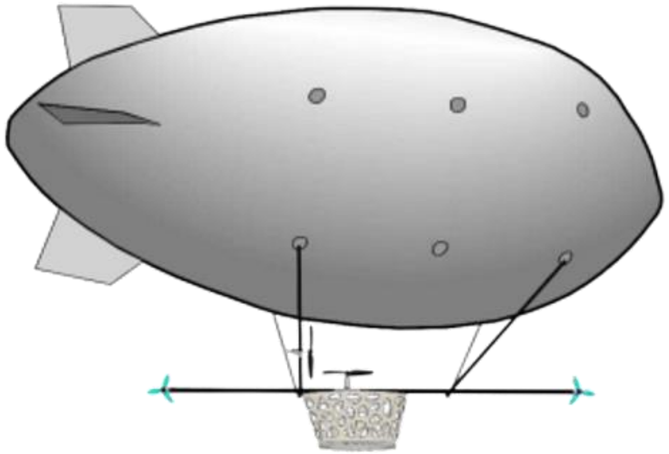
Théâtre
Antoine Vitez
Turbulences
Saint-Charles

Fonctions of the blimp

- Record the actors face.

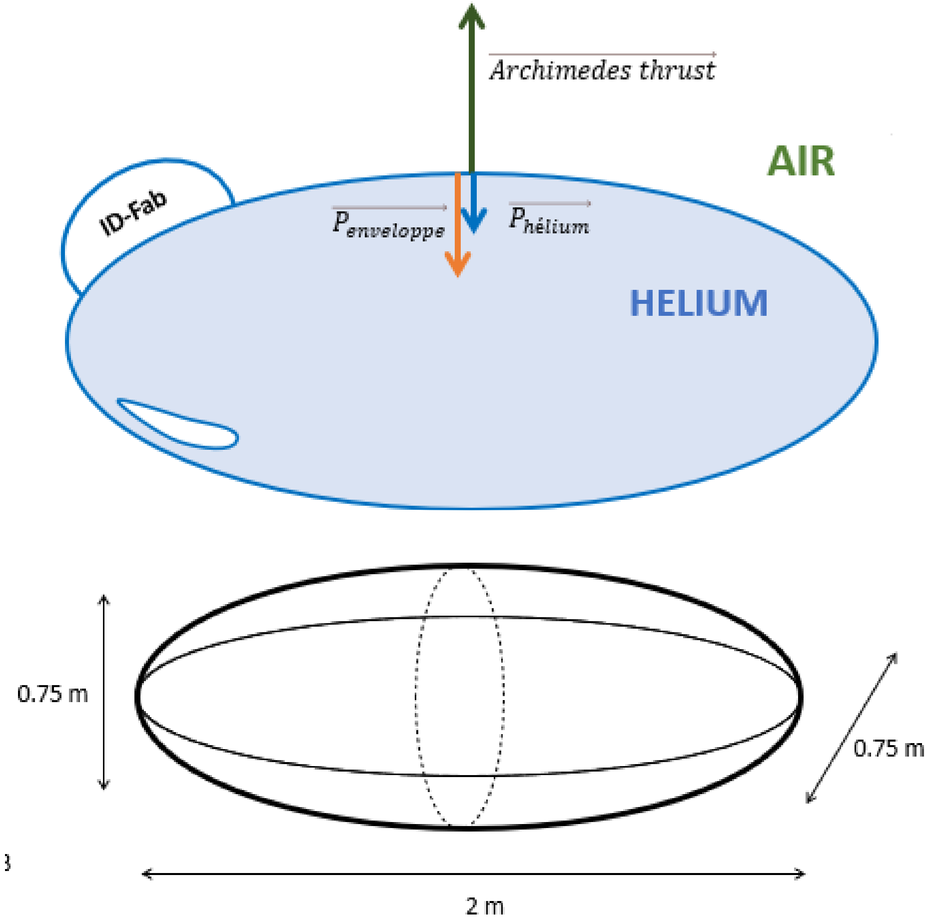
- Steady flight



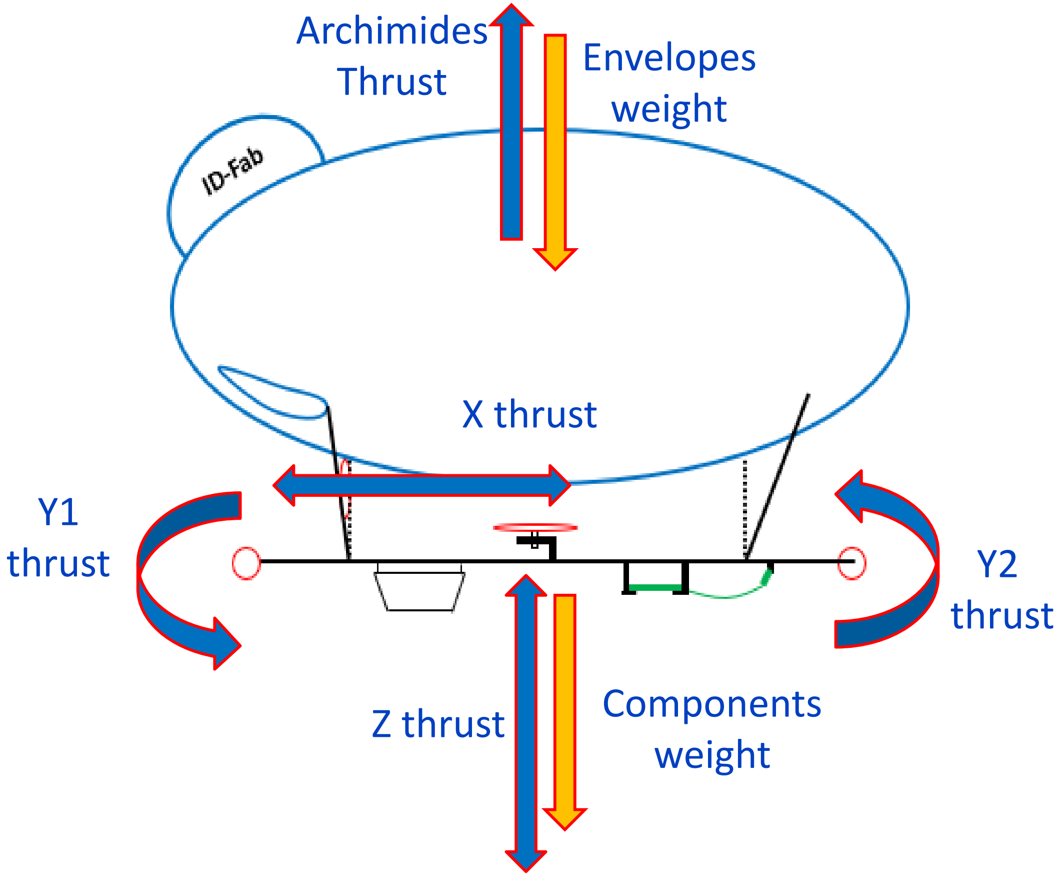
- Stream the video.

Blimp Status Upon Our Arrival

Envelope and structure

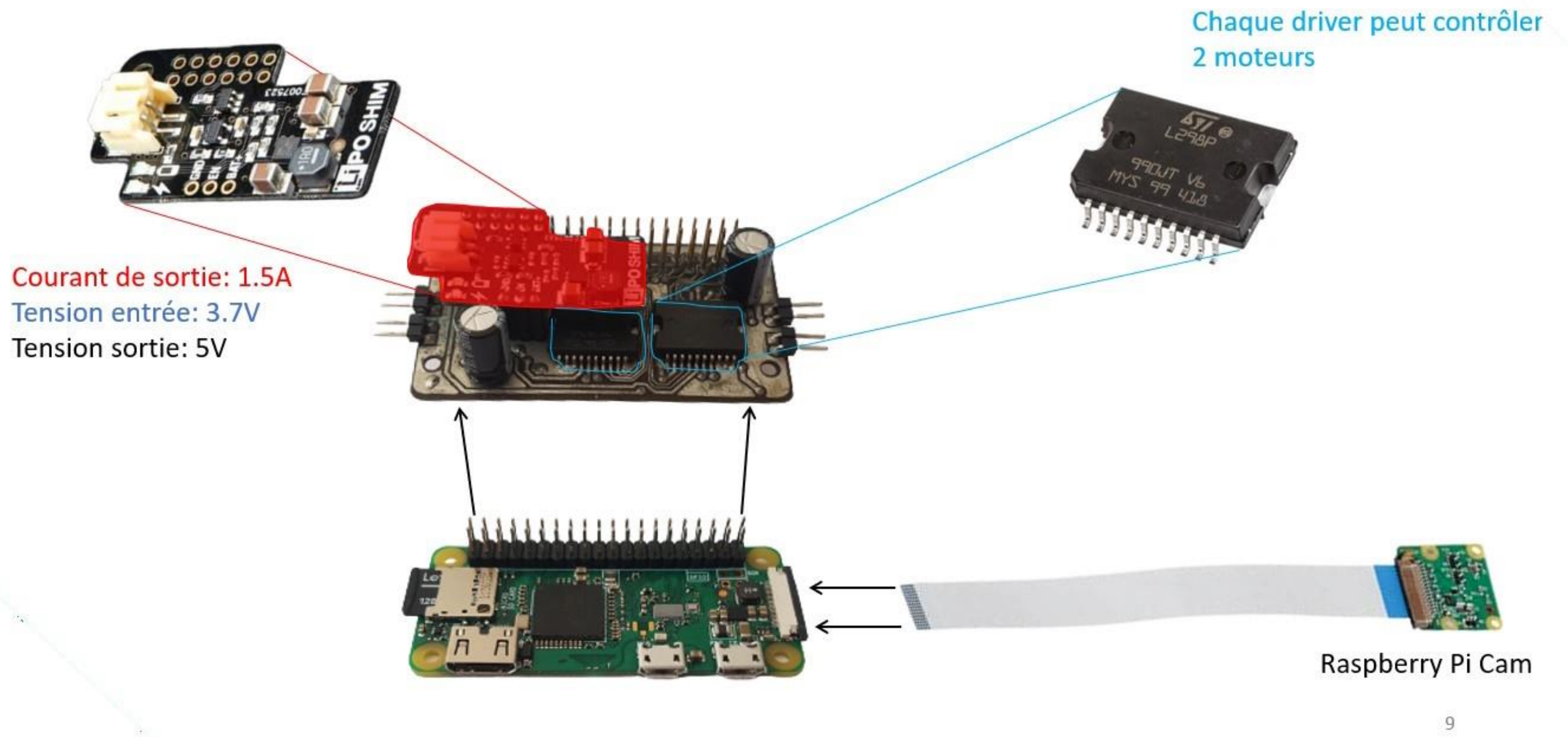


Mass balance and forces exerted.



Blimp Status Upon Our Arrival

- **Embeded electronics.**



Internship Goals

- The automation of the airship:
  - Integrate a position sensor.
  - Building a control system.
  - Evaluating the model.

Progress Made:

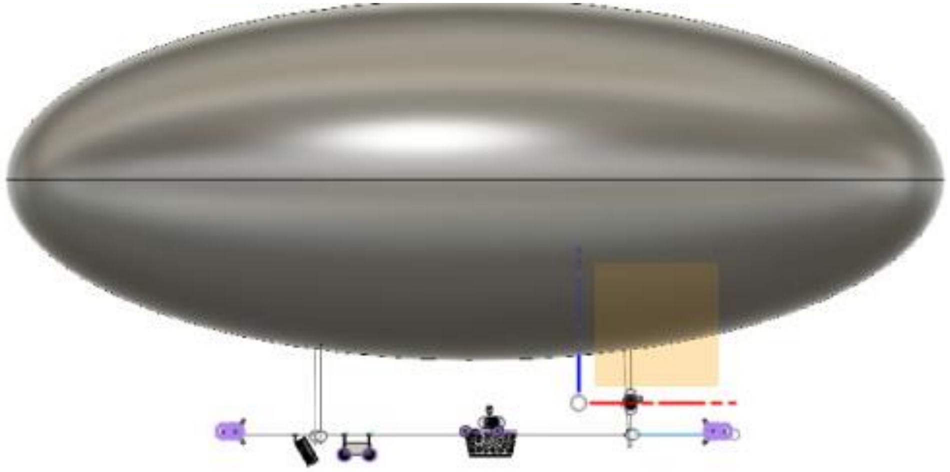
Luxonis

$$\begin{pmatrix} d_{cx} \\ d_{cy} \\ d_{cz} \end{pmatrix} = \begin{pmatrix} d_c \cdot \cos(err_{\theta_v}) \cdot \cos(err_{\theta_h}) \\ -d_c \cdot \cos(err_{\theta_v}) \cdot \sin(err_{\theta_h}) \\ -d_c \cdot \sin(err_{\theta_v}) \cdot \cos(err_{\theta_h}) \end{pmatrix}$$

$$X = \begin{pmatrix} -d_{cx} \cdot \cos(\alpha) + d_{cam} - d_{cz} \cdot \sin(\alpha) \\ -d_{cy} \\ -d_{cz} \cdot \cos(\alpha) + d_{cx} \cdot \sin(\alpha) \end{pmatrix}$$

Progress Made:
CAD Model.

- **CAD model**



- **Inertial matrix.**

$$I = \begin{pmatrix} 6{,}15 \times 10^{11}\ g \cdot mm^2 & 0 & 0 \\ 0 & 1{,}77 \times 10^{11} & 0 \\ 0 & 0 & 1{,}36 \times 10^{11} \end{pmatrix}$$

Progress Made:

Dynamic Model.

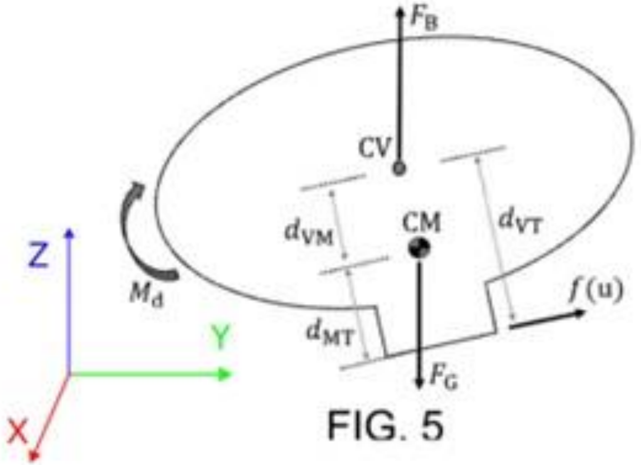
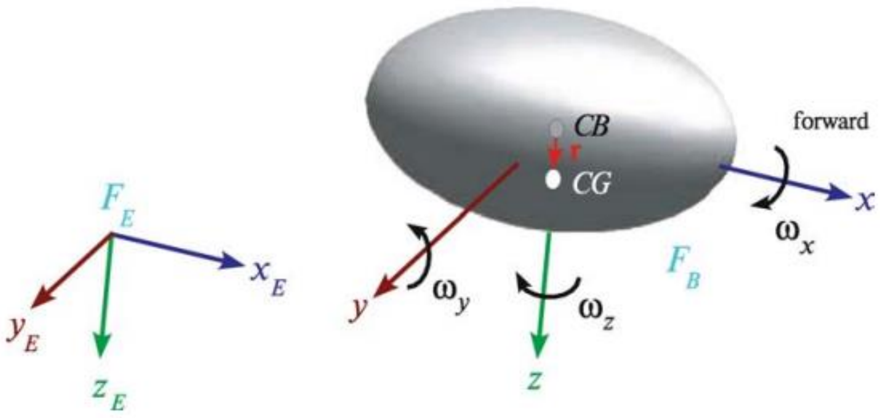


FIG. 5

$$\begin{pmatrix} m \cdot a_x \\ m \cdot a_y \\ m \cdot a_z \end{pmatrix} = \begin{pmatrix} P_{long} - D_{v_x} \cdot v_x - m \cdot v_y \cdot \dot{\psi} \\ P_{latav} - P_{latar} - D_{v_y} \cdot v_y + m \cdot v_x \cdot \dot{\psi} \\ F_g + F_{pA} + P_{alt} - D_{v_z} \cdot v_z \end{pmatrix}$$



$$\begin{pmatrix} I_x \cdot \dot{\phi} \\ I_y \cdot \dot{\theta} \\ I_z \cdot \dot{\psi} \end{pmatrix} = \begin{pmatrix} -F_{pA} \cdot d_{centres} \cdot sin(\phi) - d_{latmot} \cdot (P_{latav} - P_{latar}) - D_{w_x} \cdot \dot{\phi} \\ -F_{pA} \cdot d_{centres} \cdot sin(\theta) - d_{longmot} \cdot P_{long} - D_{w_y} \cdot \dot{\theta} \\ \frac{L}{2} \cdot (P_{latav} + P_{latar}) + D_{w_z} \cdot \dot{\psi} \end{pmatrix}$$

Progress Made:

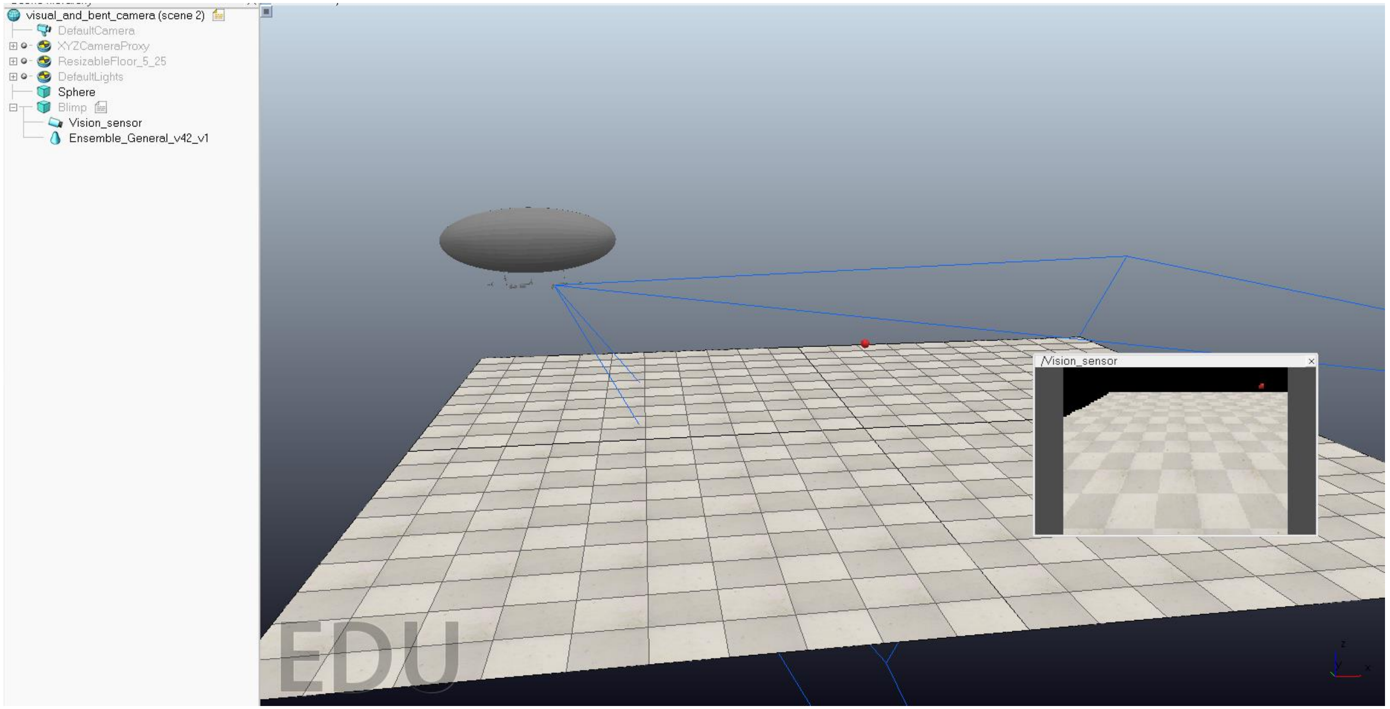
Dynamic Model.

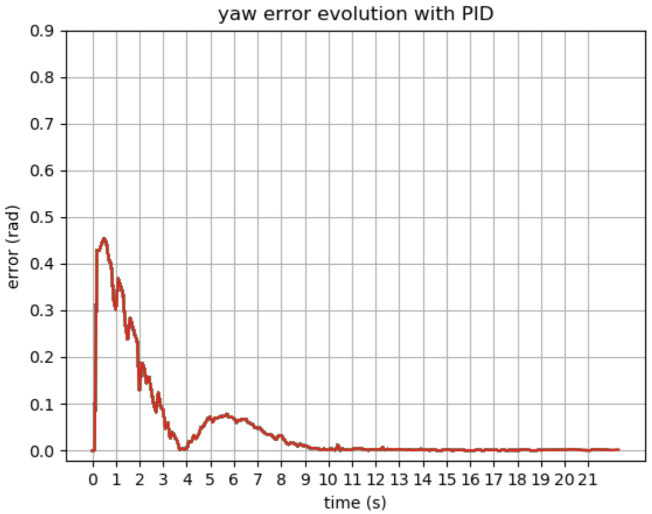
$$\begin{pmatrix} m \cdot a_x \\ m \cdot a_y \\ m \cdot a_z \\ I_z \cdot \dot{\psi} \end{pmatrix} = \begin{pmatrix} P_{long} - D_{v_x} \cdot v_x - m \cdot v_y \cdot \dot{\psi} \\ P_{latav} - P_{latar} - D_{v_y} \cdot v_y + m \cdot v_x \cdot \dot{\psi} \\ P_{alt} - D_{v_z} \cdot v_z \\ \frac{L}{2} \cdot (P_{latav} + P_{latar}) + D_{w_z} \cdot \dot{\psi} \end{pmatrix}$$

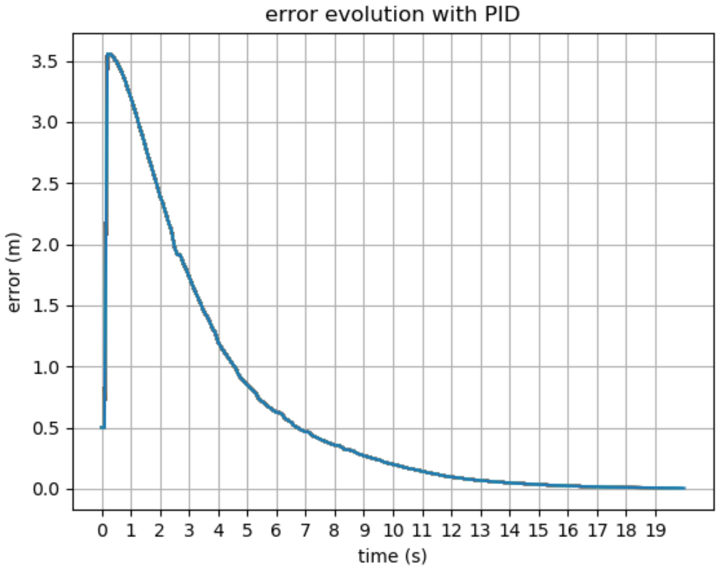
$$\dot{X} = \overbrace{\begin{pmatrix} K_{long} & 0 & 0 & 0 \\ 0 & K_{latav} & -K_{latar} & 0 \\ 0 & 0 & 0 & K_{alt} \\ 0 & \frac{L \cdot m}{2I_z} \cdot K_{latav} & \frac{L \cdot m}{2I_z} \cdot K_{latav} & 0 \end{pmatrix}}^{A} \cdot \begin{pmatrix} u_{long} \\ u_{latav} \\ u_{latar} \\ u_{vert} \end{pmatrix} + \overbrace{\begin{pmatrix} -\frac{D_{v_x}}{m} \cdot \dot{x} - \dot{y} \cdot \dot{\psi} \\ -\frac{D_{v_y}}{m} \cdot \dot{y} + \dot{x} \cdot \dot{\psi} \\ -\frac{D_{v_z}}{m} \cdot \dot{Z} \\ \frac{D_{w_z}}{I_z} \cdot \dot{\psi} \end{pmatrix}}^{B}$$

$$\boxed{U = inv(A) \cdot ((w - \int X) + 2 \cdot (\dot{w} - X) + \ddot{w}) - B}$$

Progress Made:
Control system







Conclusion

- The luxonis camera was integrated.
- The PID control works.
- The V-Rep simulation was successful.
- Next step, test in prototype.