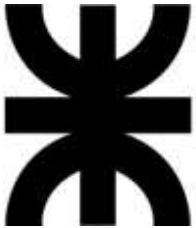
Sail deployment deorbit system by solenoids for microsatellites

Club de Robótica



Universidad Tecnológica Nacional
Facultad Regional Córdoba

Argentina

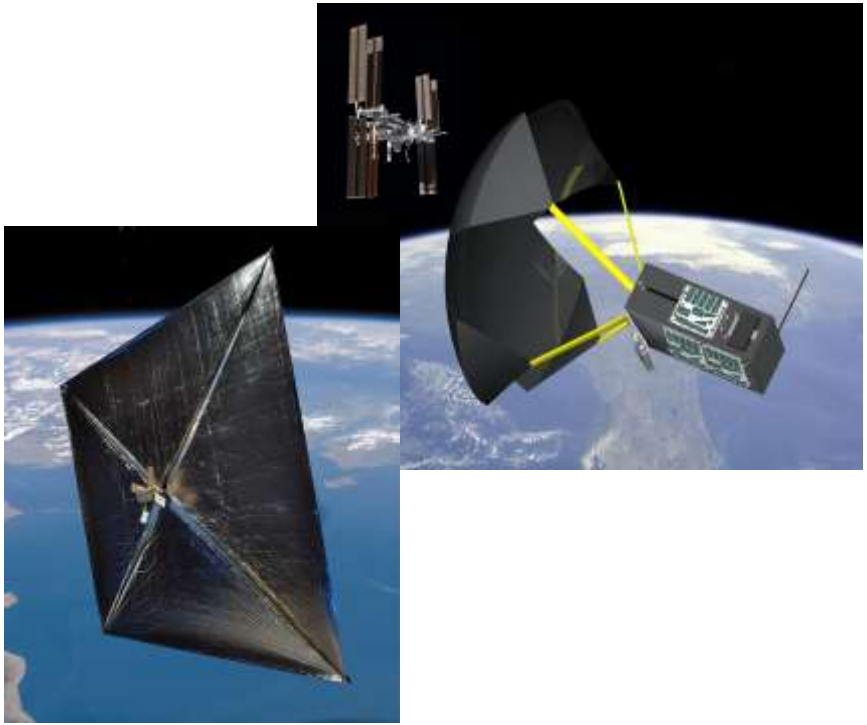
“A group of students that shares a common interest related to robotics and open-source applications
and now embarking
In the aerospace field”

UTN-FRC

The team

The beginnings

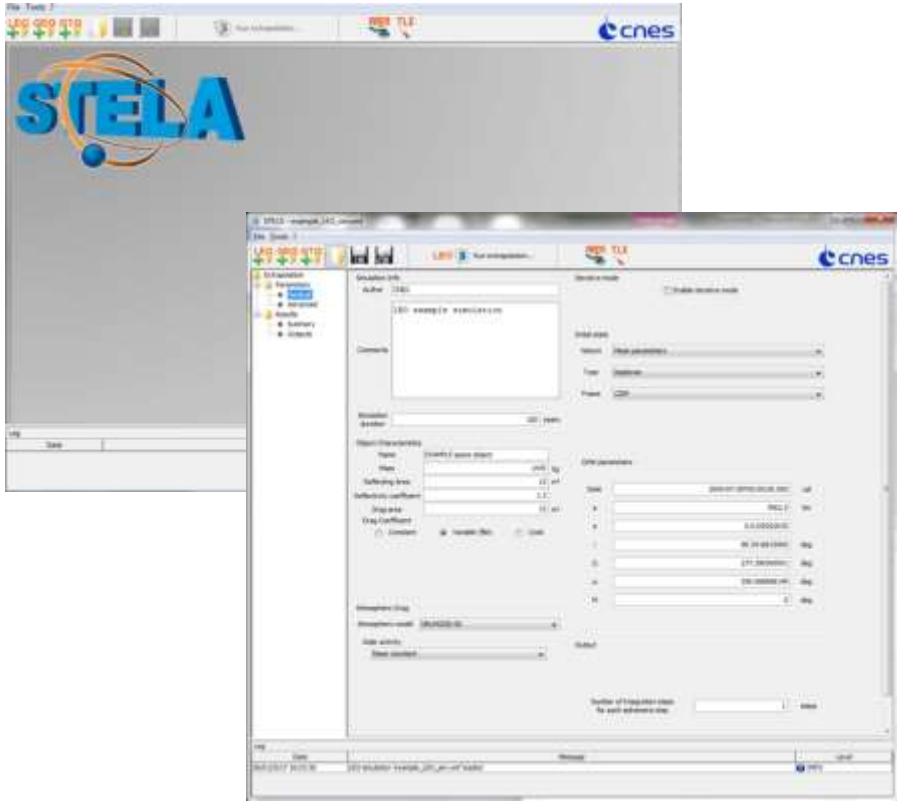
- **Atmospheric drag** is the major cause of orbital decay for LEO satellites.
- Sail deployment is a known way to augment the drag area.



Simulations

Analytic simulation tool used to propagate orbit:

- STELA v3.1.1 by CNES



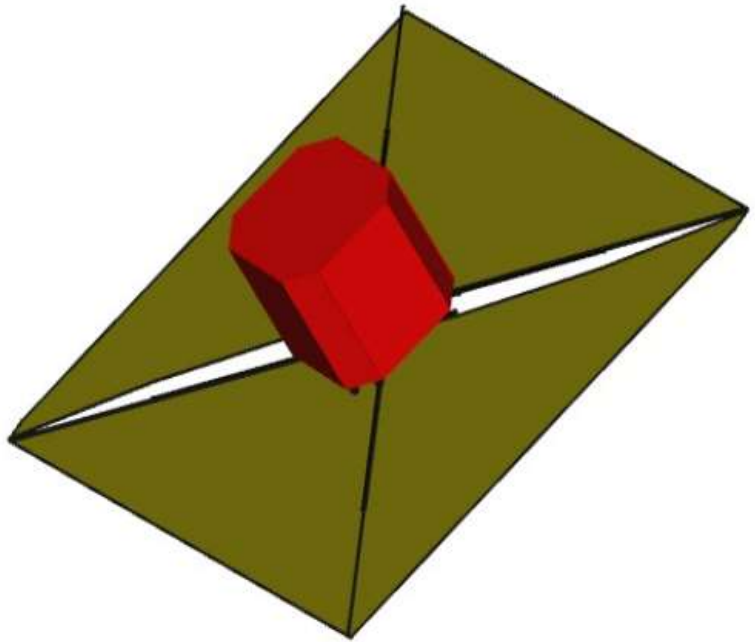
Proposed deorbit device

Our objectives:

- Scalable
- Easy construction

Description:

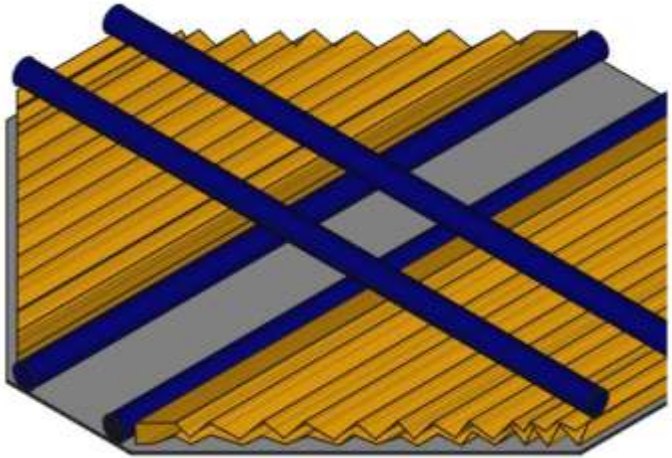
- Telescopic arms
- Move by linear motors
- Fail-safe construction
  - A bad deploy still augment the area drag area



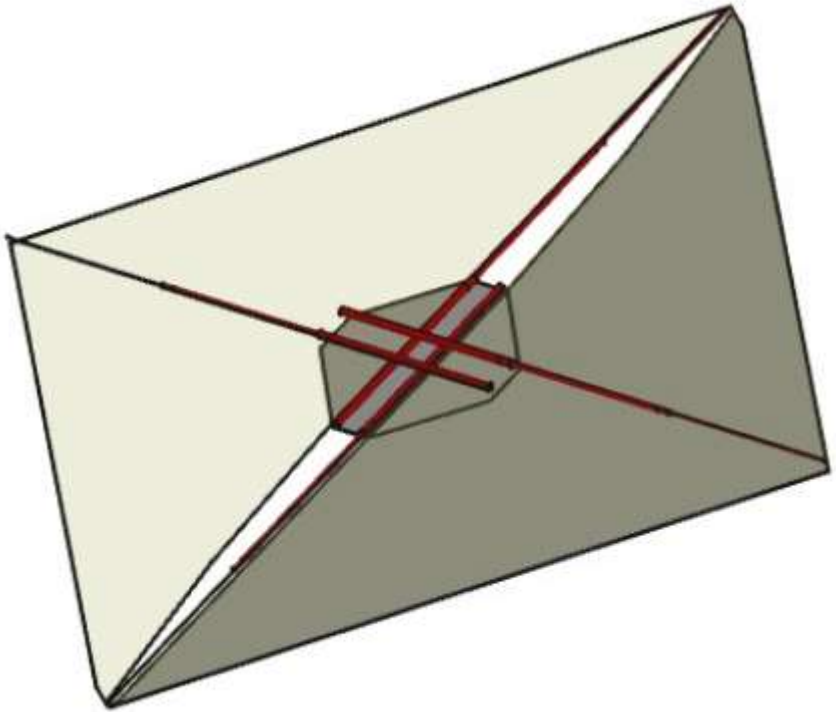
Deployment Mechanism

Principles:

- Telescopic arms.
- Interaction between the solenoid and magnets.
- Linear Motor.

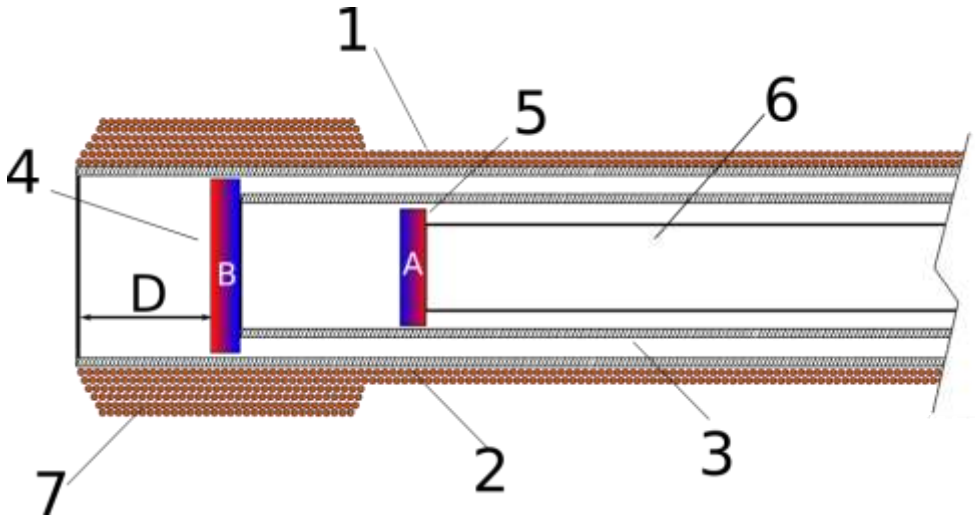


Telescopic arm



Solenoid

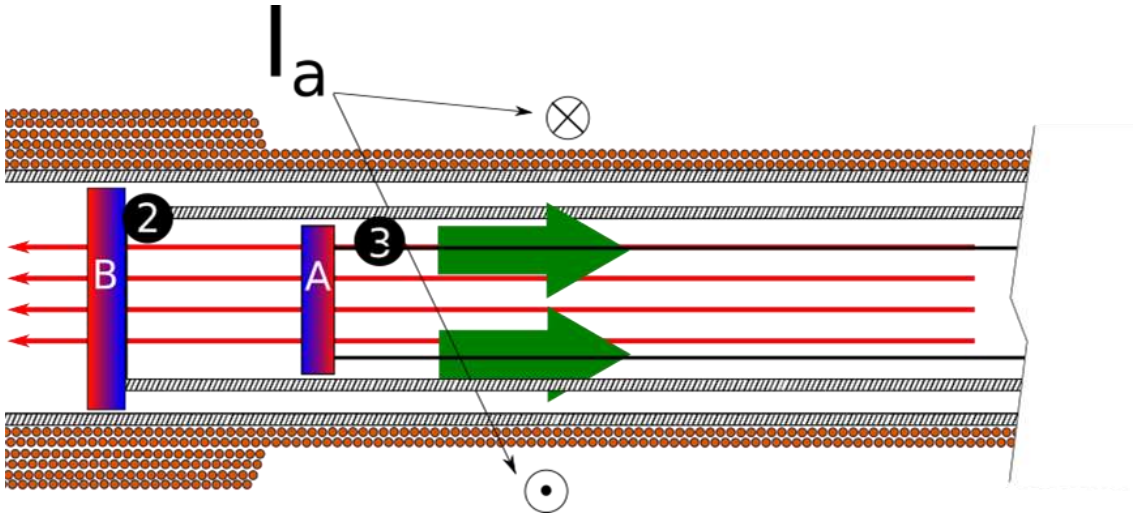
Three hollow cylinders with a copper winding to deploy a sail.



1) Copperwire.
2) Extern cylinder.
3) Inner cylinder one.
4) Magnet B.
5) Magnet A.
6) Inner cylinder two.
7) Aux. copperwire.

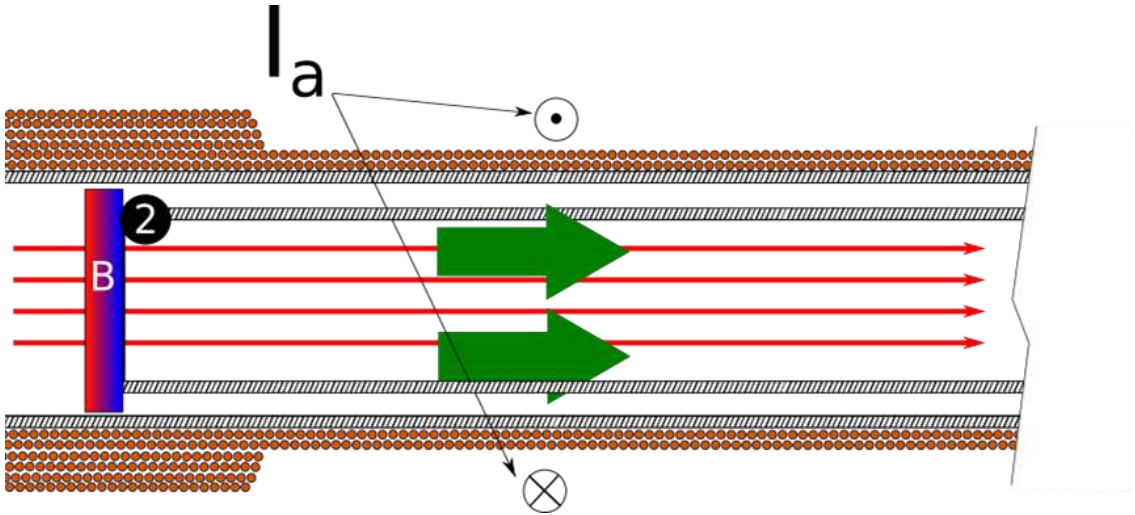
Telescopic Arms

Three hollow cylinders with a copper winding to deploy a sail.

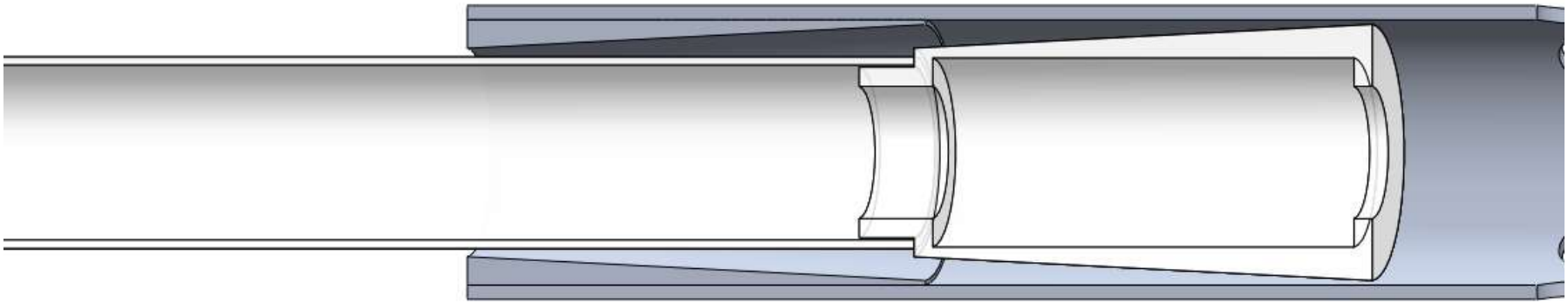


Telescopic Arms

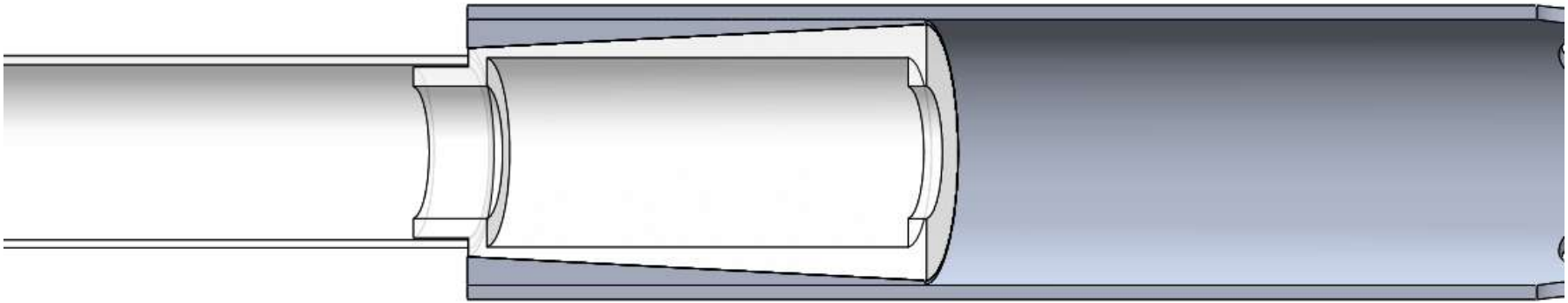
Three hollow cylinders with a copper winding to deploy a sail.



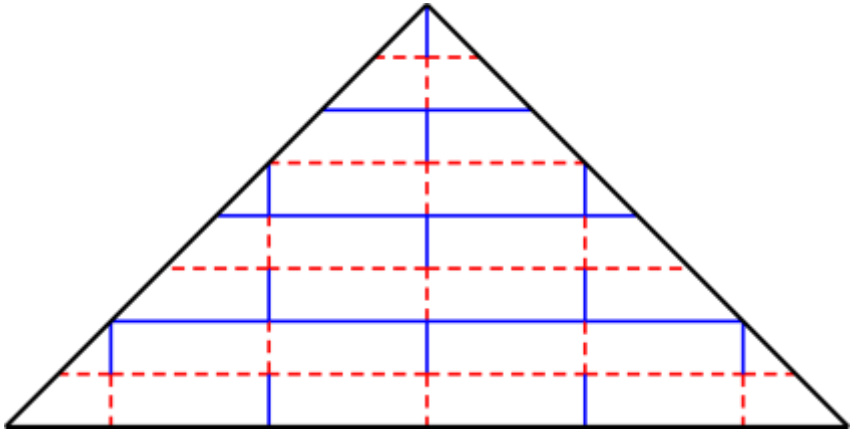
Deploy - Mechanical Stop

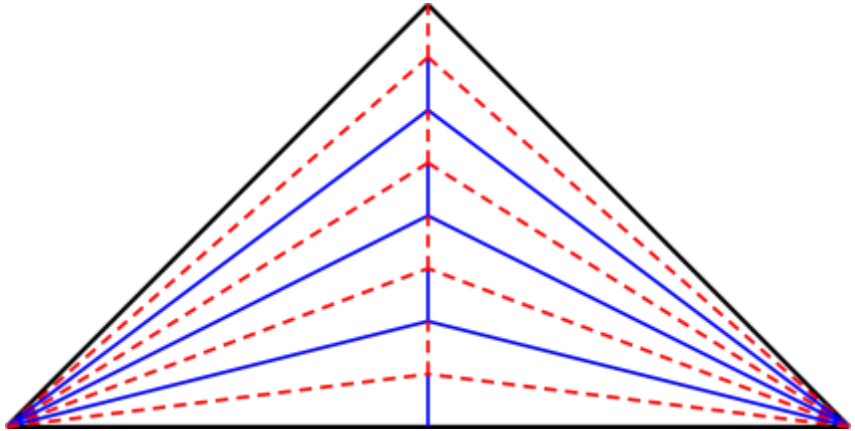


Deploy - Mechanical Stop

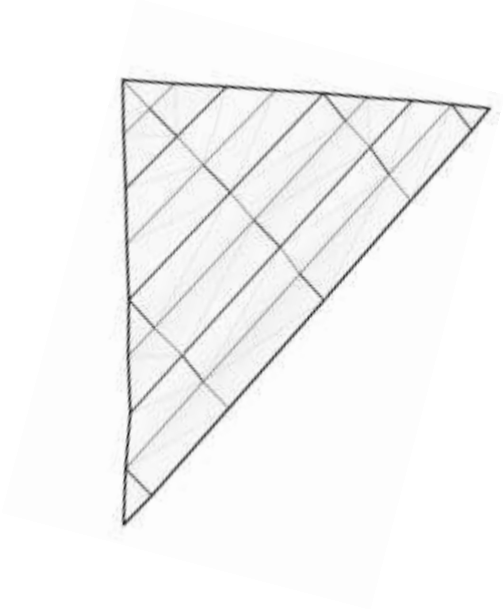


Sail Folding Pattern

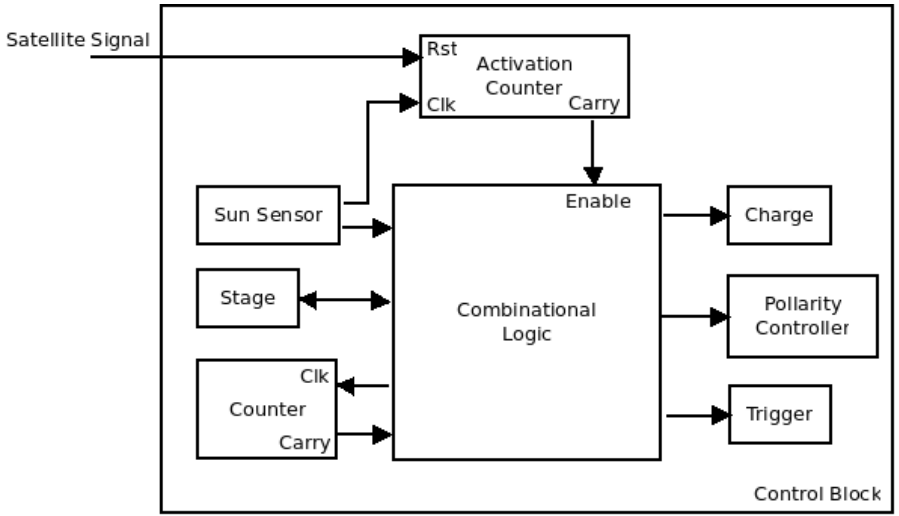


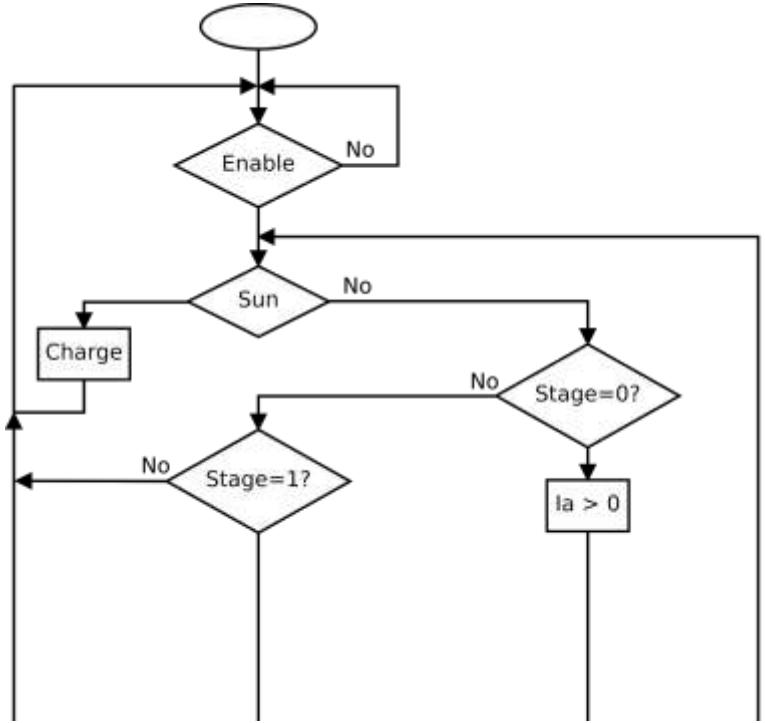


Sail Folding Pattern



Control


Satellite Signal
Rst
Activation
Counter
Clk
Carry
Enable
Sun Sensor
Charge
Stage
Combinational
Logic
Pollarity
Controller
Clk
Counter
Carry
Trigger
Control Block


Enable
No
Sun
No
Charge
No
Stage=0?
No
Stage=1?
Ia > 0

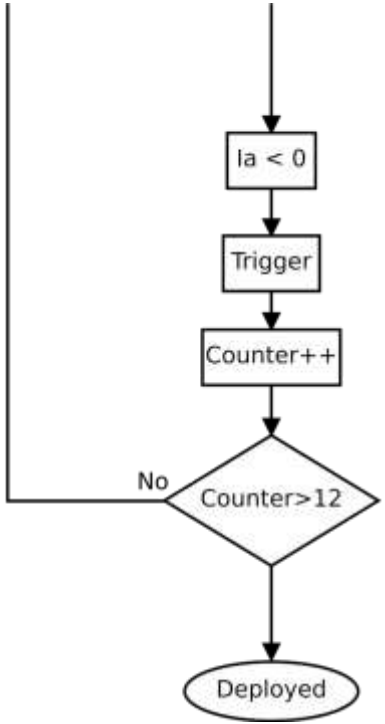
Control

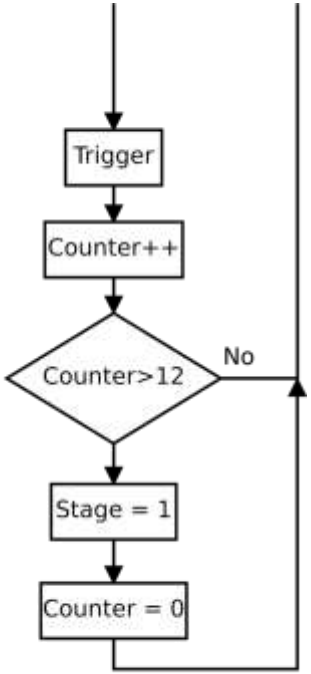
Controlling the deployment:

- Beacon type signal.
- Deactivate the deployment every 24hs.

After the satellite becomes non-cooperative:

- Beacon signal, no longer exists
- Activate the deploy, after 24hs





Conclusions

- Linear motors works well in the experiments.
- We still work to define materials

Future work:

- Microgravity tests
- Temperature stress test and redo the shape of the housing

Thanks to

Ministerio de Ciencia,
Tecnología e Innovación Productiva
Presidencia de la Nación

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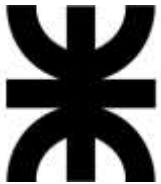

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