Admission to the 3rd year of PhD

DYNAMICS AND CONTROL OF HIGHLY FLEXIBLE STRUCTURES FOR AEROSPACE APPLICATIONS

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Space Sciences, Technologies and Measurements - STASA curriculum - XXX Cycle

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Outline

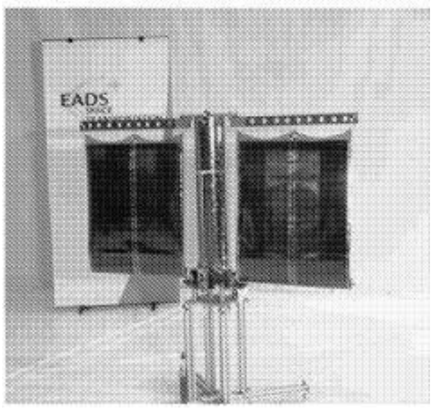
- Summary of the background and current focus
- Structural simulations on solar panels
- Simulations of the booms dynamics
- Preliminary design of the deployer
- Numerical simulations on morphing
- Conclusions and future work

Background

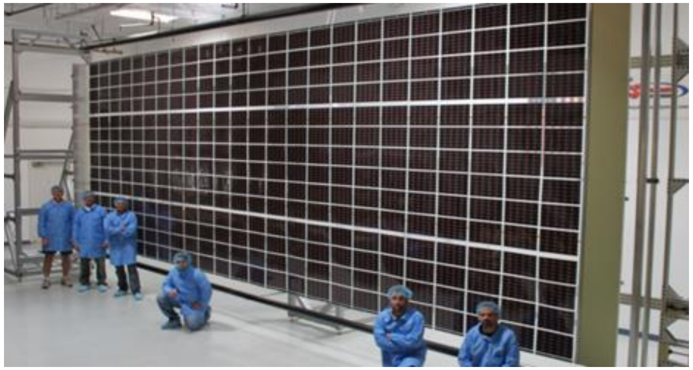
Membrane solar panels

ILC Dover, Teledesic Inflatable Solar Array

L'Garde Inflatable Torus Solar Array Technology

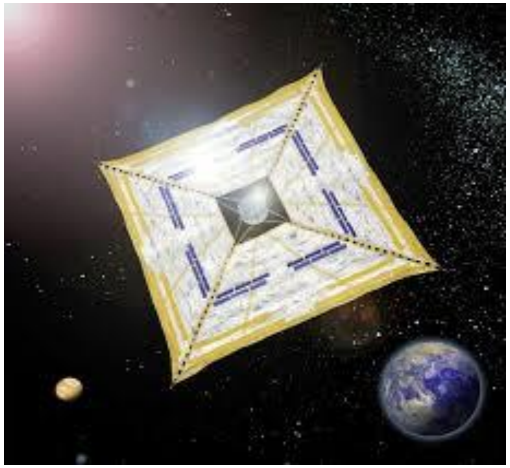


ESA/EADS Inflatable and Rigidizable Solar Array Breadboard



DSS's Mega-ROSA

Background



JAXA's Ikaros

Solar and drag sails

NASA's NanoSail-D

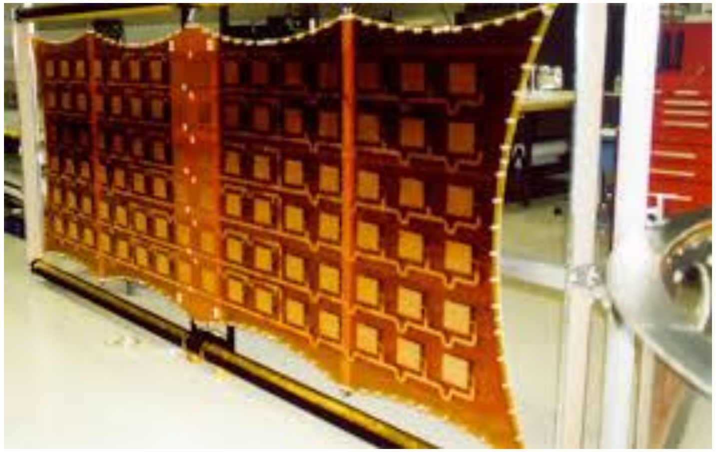
ESA/DLR solar sail

Background

L'Garde's LDP inflatable antenna

L'Garde/NASA's Inflatable Antenna Experiment

Membrane antennas



L'Garde's Synthetic Aperture Antenna

Background

Advantages:

- Lower mass and storage volume
- Lower launch costs
- Lower manufacturing costs

Drawbacks:

- Flexibility
- Low natural frequencies that can cause instabilities on the central body
- Membrane dynamics changes with:
  - tension state
  - presence of creases

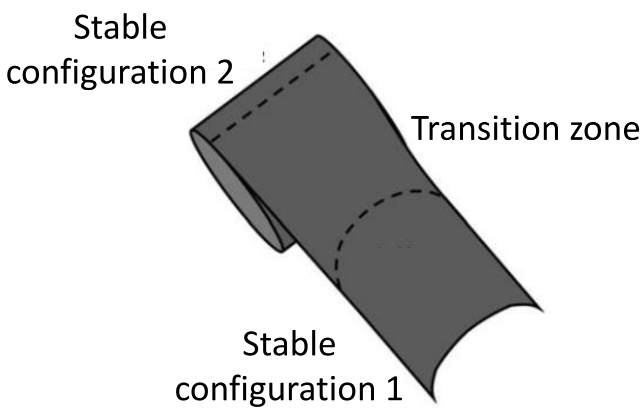
Current focus

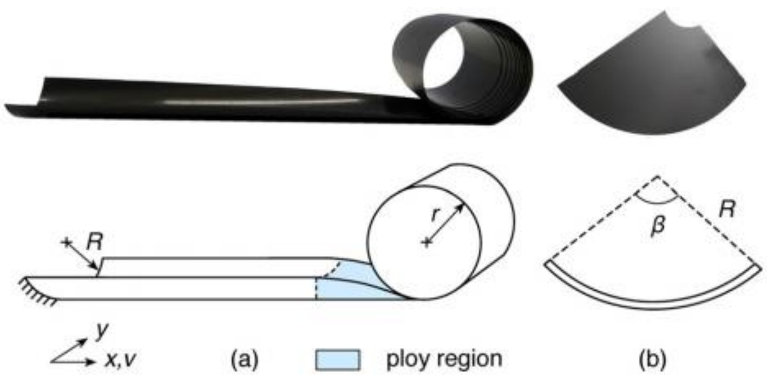
- Membrane solar panels for nanosatellites
  - About 50W of power each
- Tensioning system that keeps the membrane stretched
  - Bi-stable booms
- Deploying system
  - Motor to control the deployment rate
- Control system for damping vibrations on the booms (not included in the presentation)
  - Smart materials
  - Passive vibration control through damping materials

Bistable booms

Bi-stable booms:

- are elongated structures made of composite material (e.g. CFRP, GFRP…)
- have low mass per unit length (e.g. 65 g/m)
- can be stored in a compact fashion inside the satellite
- present two well-defined stable equilibrium configurations: the deployed (unrolled) and the stowed/coiled (rolled) one, with the lowest strain energy





[Slides 9-29]

Conclusions and future work

Thanks for your attention!

Any questions?