Comparison of Maximum Power Point Tracking Techniques in Electrical Power Systems of Cubesats

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Agenda

• Introduction
  – From Libertad 1 to Libertad 2

• The problem
  – Selection of MPPT algorithm for EPS

• Method
  – Simulation over one orbit of MPPT techniques

• Results
  – Comparison of Energy for each Technique
  – Future work
Introduction

• Classification: Nanosatellite
• CubeSat (Academic)
• Application: Earth Observation
• Orbit: LEO
Introduction

Ground Station
Introduction

1. Development of an image acquisition system for Cubesat

2. Optimization of power systems
The problem

Irradiance

Temperature

\[ V_{PV}, I_{PV} \]

PV Module

DC

DC

\[ V_B, R_{LOAD} \]

Perturb-and Observe (P&O)
Linear Reoriented Coordinates Method (LRCM)
The problem
Environment conditions

Sunlight

Illuminated area

Dark area

Irradiance [W/m²] vs Time [h]

- Side 1
- Side 4
- Side 3
Environment conditions

- Sunlight

- Illuminated area

- Dark area

- Graph showing temperature [°C] over time [h]

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Donde tú sí cuentas.
Results
Results

![Graph showing voltage and current over time]
Results

![Graph showing power and time with Ideal Power, P&O Power, and LRCM Power.](image)
Conclusions

• The ideal operating point of the PV cells was estimated during the orbit sunlight period to be used as a benchmark for the MPPT comparisons.

• Both MPPT methods presented a similar performance over an entire sunlight period.
Conclusions

• An effective operation of LRCM requires precision in the mathematical model of the PV panel.
• LRCM could be implemented without the disconnection of the PV panel
• In the case of P&O method, a careful selection of the sampling time and the step size must be done for its correct operation.
Future work

- Different situations without attitude control are being analyzed to know the performance of the MPPT.
Future work
Future work

1. Experimental validation

2. Experimental validation
Thank you!

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Questions?

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References

References


• Azur Space. 30% Triple Junction GaAs Solar Cell. 2012. Available at: http://azurspace.de/index.php?mm=162.
References


• Erb D. Evaluating the Effectiveness of Peak Power Tracking Technologies for solar array on small spacecraft. Master Thesis. University
### Lighting

**Satellite-Libertad2:** Lighting

#### Sunlight Times

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#### Penumbra Times

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• Eccentricidad=0.009
• Inclinación=98 grados
• Longitud de nodo ascendente=191 grados
• Argumento del perigeo=189 grados
• Anomalía verdadera=0 grados