DESIGNING, SIMULATING, AND TESTING THE POWER SUBSYSTEM FOR RAPID

MIT Haystack REU 2013
OUTLINE

- Introduction to RAPID

- 3 Power Subsystem Components
  - Solar Panel
  - Battery
  - Charge Controller

- Python Power Model Simulation
  - Demonstration

- Test Bed

- Summary
Portable field units for conducting radio interferometry

Consists of:

- Antenna
- LNA
- Atomic clock
- FPGA
- Storage unit
- Power subsystem
In order to produce large numbers of antennas, hardware must be efficient, reasonably sized, cost effective, shippable, etc...

Advantages:
- Independent
- Reconfigurable
- Transportable to ideal location for observations
- Large number of baselines
- Wide field
- Wide frequency range

To maximize portability, each unit must contain an easily transportable power supply
Power Subsystem

Contains:
- Photovoltaic Panel
- DC/DC Converter
- Battery
- Charge Controller

Diagram:
- Energy Unit
  - Batteries
  - DC/DC Converter
  - Solar Panel
  - Charge Controller
  - Load
Considerations:
- Efficiency
- Size/Weight
- Cost

PHOTOVOLTAIC PANEL

SunPower E19

Grape Solar
3 Types of Batteries:

- Lead Acid
- NiMH
- Lithium Ion

Selected for RAPID
CHARGE CONTROLLER

- Morningstar’s SunSaver PV System Controller

SunSaver Charging Algorithm

START

- Battery Voltage > 15.3 V?
  - No
  - Battery Voltage < 11.5 V?
    - No
    - Battery Voltage < 14.1 V?
      - Yes
        - Enter Bulk Charge Mode
      - No
        - Battery Voltage < 14.1 V?
          - No
          - Enter Absorption Mode
          - Yes
            - Time < 3 Hours?
              - No
              - Enter Float Mode
- Python simulation
- Uses discrete time steps
- Easily configurable for different load profiles, solar panels, and geographic locations
Load Profile:
5 hour experiment
On 30 min, off 30 min

[400,400,300,300,300] W/m²

SOC = 13.5 A-hrs
V_{Bat} = 13.2 V
Important to get an idea of how the power system will perform before deploying the antennas

Utilize the python simulation as well as the test bed to get a sense of how feasible an experiment is

Better understand the solar panel and battery capacity needed to run RAPID

The model will continue to be developed as more variables become known
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Questions?
REFERENCES
