Automated Ground Station & the GENSO Project

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PolySat - Cal Poly

Background

- Cal Poly's first two satellites: CP3 & CP4
- Launched 4/17/07 - 2 years old!
- Still working
- 2 to 4 passes per day per satellite
- Satellites operate on 70 cm band, LSB, AX.25 packet

The Problem

- Lots of student-hours to schedule
- Comm issue - takes persistence to get uplink
- Lacking motivation to run passes that don’t produce much data

The Solution

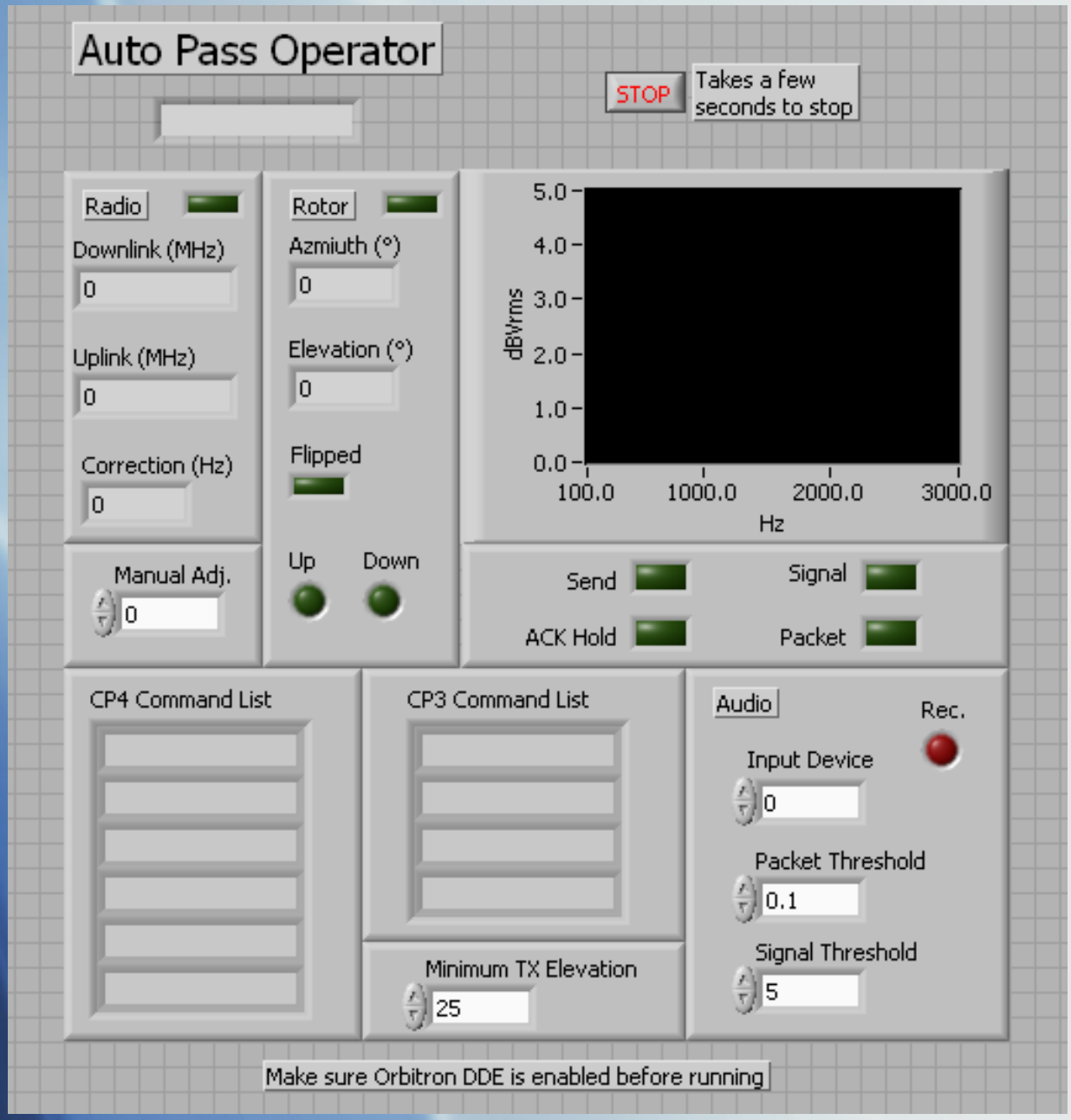
- Replace the human
- Software that automates the process of running passes and records the resulting data

Requirements

- Satellite Az/El
- Doppler Correction
- Radio/Rotor Serial Interface
- Audio analysis for automatic fine-tuning
- Operate multiple passes without human intervention

Programming Language

- LabVIEW has built-in capabilities
  - Serial Communications
  - Audio waveform analysis
  - DDE interface to satellite tracking programs like SatPC32 or Orbitron
- Just have to make features work together


Auto Pass Operator
STOP
Takes a few seconds to stop
Radio
Downlink (MHz)
0
Uplink (MHz)
0
Correction (Hz)
0
Rotor
Azmiuth (°)
0
Elevation (°)
0
Flipped
Up
Down
5.0
4.0
3.0
2.0
1.0
0.0
dBVrms
100.0
1000.0
2000.0
3000.0
Hz
Manual Adj.
0
Send
Signal
ACK Hold
Packet
CP4 Command List
CP3 Command List
Minimum TX Elevation
25
Audio
Rec.
Input Device
0
Packet Threshold
0.1
Signal Threshold
5
Make sure Orbitron DDE is enabled before running

Rotors

MixW Up

Orbitron

APO

Serial

Audio

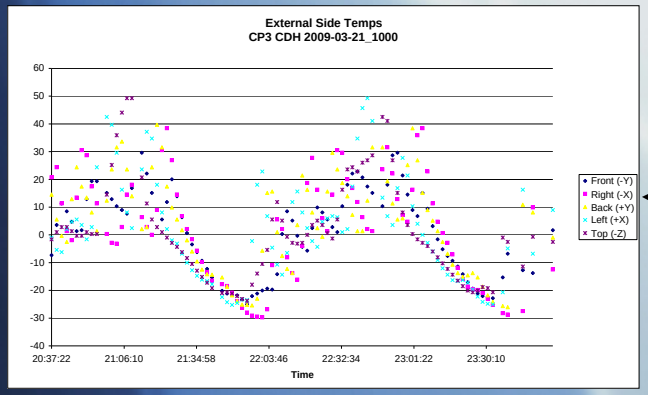
DDE

Radio

Serial

Audio

Data Out



MixW Down

Serial

Audio

N6CP - Current log: MixW2.log - MixW

File Edit Mode Options View Configure Help

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N6CP>N6CP>UI,C,F0 (1200 baud):
..U....Ì<□.□.àE×Ë6.€Á6.žA‡.U....È:,2Š.Ó2ÓË..{È?.
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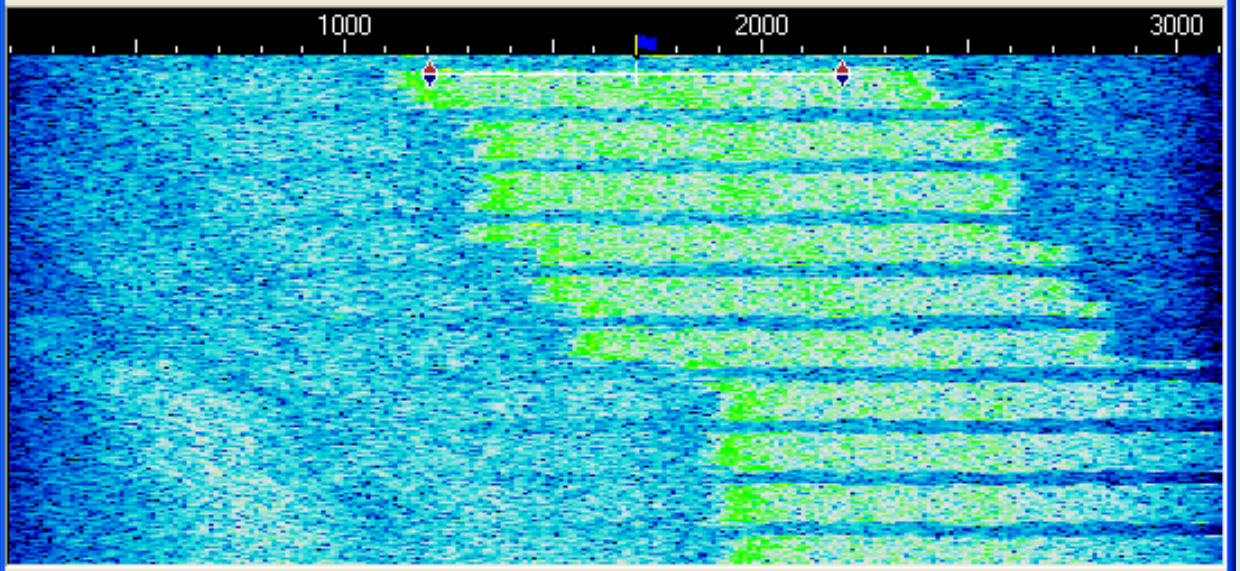
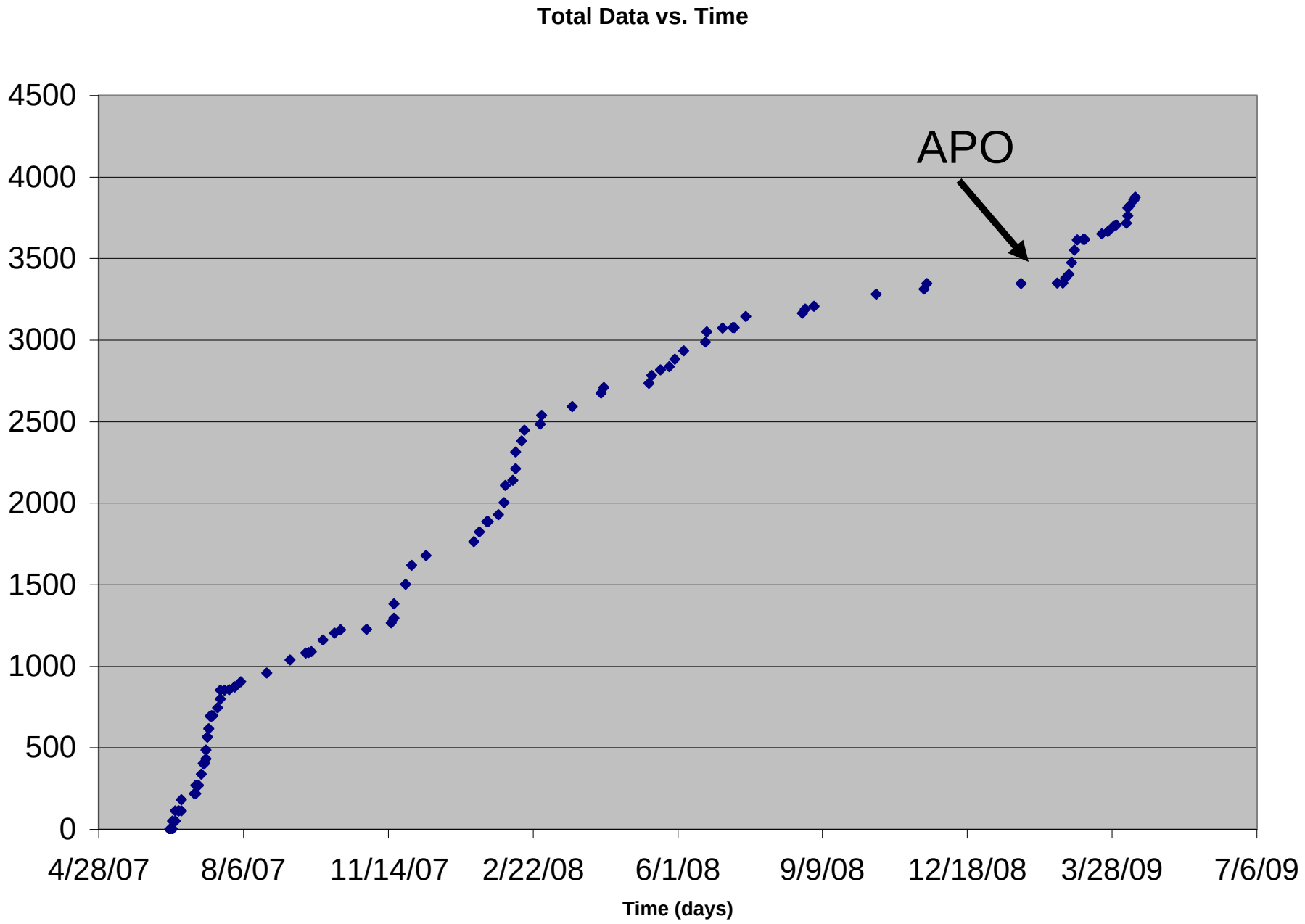


Disconnected | DCD* | AFC | Lock | Snap | 1700.0 Hz | 1200 baud | PACKET | 04/23/2009 | 04:41:24 z


Total Data vs. Time
4500
4000
3500
3000
2500
2000
1500
1000
500
0
APO
4/28/07
8/6/07
11/14/07
2/22/08
6/1/08
9/9/08
12/18/08
3/28/09
7/6/09
Time (days)

Results

- Before Auto Pass Operator
  - Average 5 KB/day downlinked
- With Auto Pass Operator
  - Average 10 KB/day downlinked

Automated Operations

- Without automated operations, we'd need people for 30 minutes each day
- What if we had contact for ~16 hours a day?
- Automated operations become essential

GENSO

- Global Educational Network for Satellite Operators
- Goal: Connect ground stations all over the world via the internet to create a global network for satellite communications
- An ESA managed project with students working from ESA, USA, JAXA, and CSA

Current GENSO Progress

- New development cycle to enable agile development
- Include real time audio streaming
- Closed loop frequency tracking

How can I get involved

- 1st Release in September
- US Mailing List
  - http://atl.calpoly.edu/mailman/listinfo/genso-us