COlorado NanosaT Atomic Clock Testbed

Satellite Timing System

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Sponsor: Air Force Research Lab

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Project Overview

Project Objective

Develop a testbed capable of ensembling three or more low SWaP atomic clocks and produce an accurate and robust time signal for small satellite applications

3-Year Deliverable

Design, build, and operate a standalone testbed with the following capabilities:

- Multiple clock ensemble configurations, including dissimilar clock inputs
- Modular software to facilitate testing of various filtering algorithms
- Fault induction, fault injection & management algorithms
Testbed Signal Processing Chain

1. Select clocks to be ensembled
2. Measure and characterize clocks
3. Filter and ensemble clock measurements
4. Generate a sinusoidal signal steered by ensemble output
5. Measure and characterize generated signal

1a. Induce fault
2a. Inject fault
Clock Ensemble Testbed

Looking Forward

- Implement and integrate the software subsystems in GNU radio:
  - Measurement subsystem
  - Filtering and ensembling subsystem
  - Signal generation subsystem
  - Fault injection and detection subsystem

- Realization of the steered output signal:
  - Generating output signals using different SDRs
  - Exploring auxiliary software/hardware options

Testbed Block Diagram
MAXWELL Cubesat & CSAC Experiment

Experiment Summary

● MAXWELL
  ○ AFRL UNP-9 Mission - 6U CubeSat

● CSAC Experiment
  ○ Purpose: Characterize CSAC performance on a space platform
  ○ Data Acquisition:
    ■ Total data acquisition time: 5 days
    ■ Frequency of data acquisition on the GPS: 0.2 Hz
    ■ GPS Data: Positioning, Clock Bias, Pseudorange, Phase
    ■ CSAC Data: Temperature, Phase
MAXWELL Cubesat & CSAC Experiment

Looking Forward

- Redefine CSAC Experiment ConOps
  - Develop new plan for CSAC orbital experiment due to data budget constraints
- Electromagnetic Field Testing
  - Use Helmholtz cage to characterize the CSAC performance under electromagnetic fields
- Thermal chamber testing
  - Characterize the CSAC performance under varying temperature profiles
- MAXWELL Antenna Functional Testing
  - Ensure the GPS antenna can accurate acquire satellites
Fall 2021 Recruitment

- Hardware testing in a lab!
- Leadership opportunities - Project Manager & Systems Engineer
- Develop CubeSat flight experiment
- Both remote and in-person opportunities

Interested?

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Questions?