CougSat I Simulation Suite

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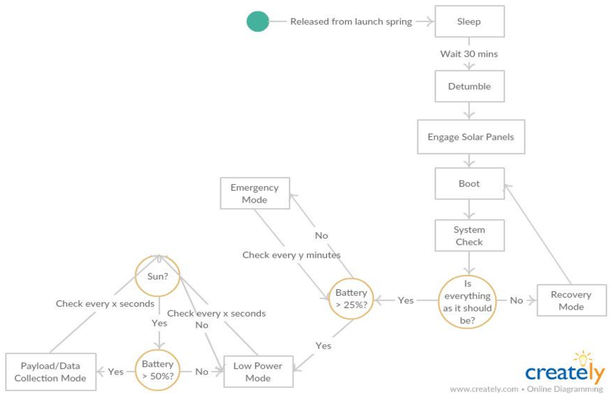
Background

Cougs in Space needs modelling software to help them get a better understanding of engineering requirements for their cubesat, adhere to NASA's launch requirements, and to visualize satellite behavior from launch to orbit. This software should also promote and develop the skills necessary for designing, manufacturing, and testing of the physical cubesat.

Goal

- Deliver the most accurate representation of the cubesat, ground station, and LEO environment
  - Implement state machine of the cubesat's behaviors
  - Create accurate model of the cubesat
  - Exhibit behaviors similar to the orbiting satellite
  - Build an interactive ground station interface
  - Integrate everything into a physics engine that will act as our LEO environment
- Make this software easy for our clients to use
  - Wrap all those components into one package

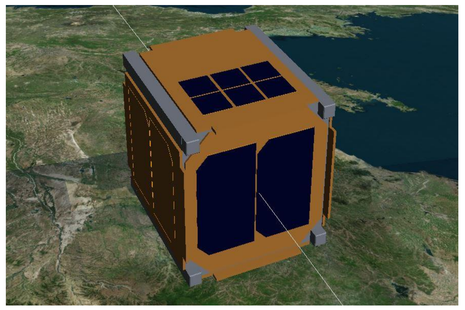
Logic



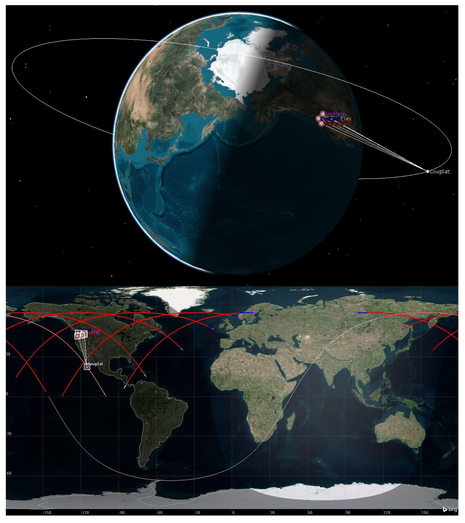
Technologies

Implementation

We began by creating a Python script with a config file to launch STK, create a custom scenario, and generate access reports from the satellite to the ground station.

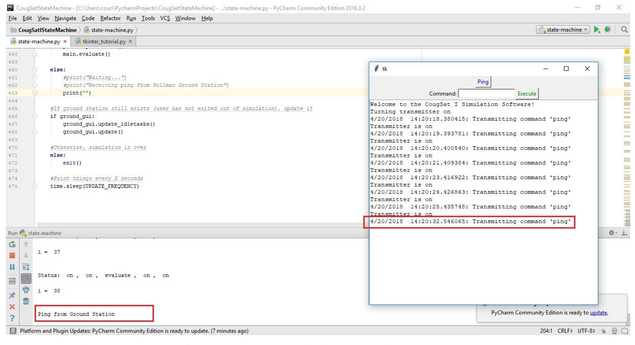


We then created a 3D model of the satellite using a COLLADA (.dae) file. There are custom-made solar panels on four sides of the model. We then integrated the .dae file into the Python script.



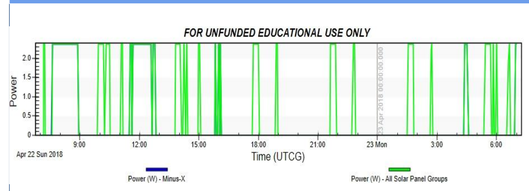
The simulation runs for the duration specified by the user in the config file. The user can also select an orbit type and a launch location.

When the satellite passes the coverage area of a ground station, the access interval (left), is recorded in the access report.



The Ground Station UI (right) interacts with the satellite's state machine (left) in the same manner the real ground station and CougSat I will behave.
Whenever the satellite is in range and the ground station sends a ping or other command, the satellite will receive the command, decrypt it, and respond to it appropriately.

Results



- Solar panel input
- How much power can be generated per orbit

	Location	Start Access Time	Stop Access Time		Location	Start Access Time	Stop Access Time
2							
3	Pullman	04/21/2018 19:45:25	04/21/2018 19:54:42		Tri Cities	04/22/2018 00:39:48	04/22/2018 00:51:57
4							
13	Pullman	04/22/2018 04:00:06	04/22/2018 04:05:46		Everett	04/21/2018 23:00:20	04/21/2018 23:12:24
14							
15	Spokane	04/21/2018 19:45:45	04/21/2018 19:54:37		Everett	04/22/2018 00:39:13	04/22/2018 00:51:16
16							
17	Spokane	04/21/2018 21:22:39	04/21/2018 21:34:16		Everett	04/22/2018 02:18:17	04/22/2018 02:29:30
18							
27	Tri Cities	04/21/2018 19:45:11	04/21/2018 19:54:10		Vancouver	04/22/2018 00:39:10	04/22/2018 00:51:22
28							
29	Tri Cities	04/21/2018 21:22:08	04/21/2018 21:33:52		Vancouver	04/22/2018 02:18:17	04/22/2018 02:29:55
30							
31	Tri Cities	04/21/2018 23:00:45	04/21/2018 23:12:57		Vancouver	04/22/2018 03:58:13	04/22/2018 04:06:32

- Time periods when satellite is in range of ground stations
- Helps optimize transmission and receiving time windows

Future Work

- Incorporate more features of CougSat I into the state machine
  - The payload specifications remained unknown during our development
  - The temperature thresholds of individual boards and components were also unknown

Glossary

COLLADA file: COLLAborative Design Activity. An interchange file format for interactive 3D applications and models
Config file: Configuration file containing variables for the simulation
Cubesat: A type of miniaturized satellite commonly used for space research that is made up of 10×10×10 cm cubic units
ROS: Robot Operating System. Used to emulate hardware and software behavior
STK: Systems Tool Kit. A physics engine and aeronautical analysis tool created by AGI

Acknowledgements

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TEAM VIKING