CACTUS-I

Mission Quality Assurance: Virtualizing Design

Coordinated **A**ssigned **C**apitol **T**echnology **U**niversity **S**atellite
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Abstract:

By using Virtual Design tools to create prototypes, visualize concepts and develop designs, we reduce the material costs and delays in hardware prototyping. Rapid design iterations are possible when the model is both virtual and accurate. We discuss a design and development flow that leads to virtual models that are physically feasible and provide a measure of quality assurance prior to material acquisition and building.

Mission Description:

CACTUS-I will demonstrate the use of Silica Aerogel for the use of capturing and profiling micro space debris and micrometeorites as well as testing the performance of high bandwidth IP based communications (CIV) against conventional amateur radio. While doing so, CACTUS-I will remain primarily open-source with a concession to requiring some licensed hardware components.

Along with the aerogel experiment, CACTUS-I will house an experimental communications payload that is utilizing the Iridium Constellation acting as a low cost, low power solution to provide the following:

- Altitude
- Doppler location
- Health and Safety

Testing & Documentation:

Documentation is critical for keeping the mission on track and is able to provide significant guidance for the team members and the future students of CapTechU. Written assembly instructions accompanied by virtual assembly videos make assembly simple enough for any team member to perform. Simulations and testing are easily performed and data/results are recorded from programs like Autodesk Inventor's Simulation environment or the SNAP program developed in MATLAB.

Tools:

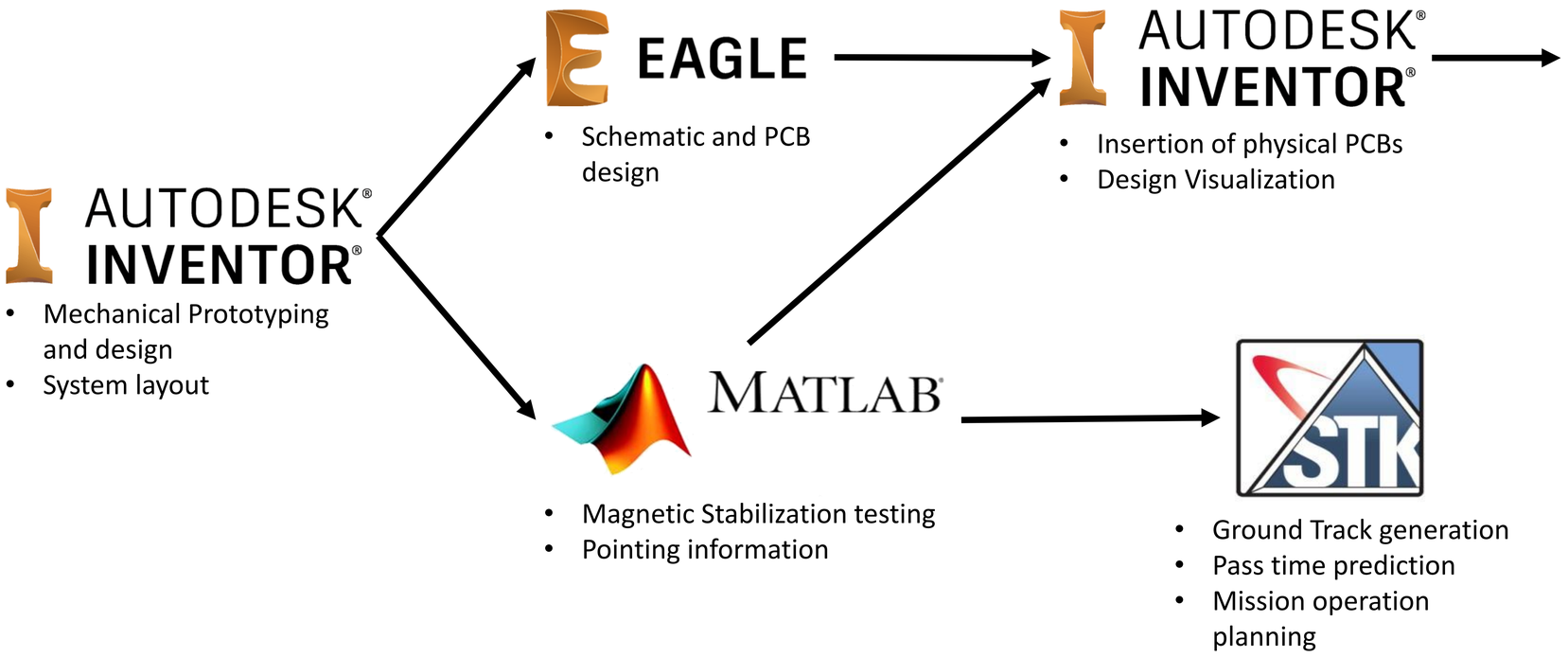
Capitol Technology University utilizes many tools to perform advanced analysis on various systems. Tools such as MATLAB, STK 13, Autodesk's Inventor, and Autodesk's EAGLE provide accurate visualizations of the components and systems performance.

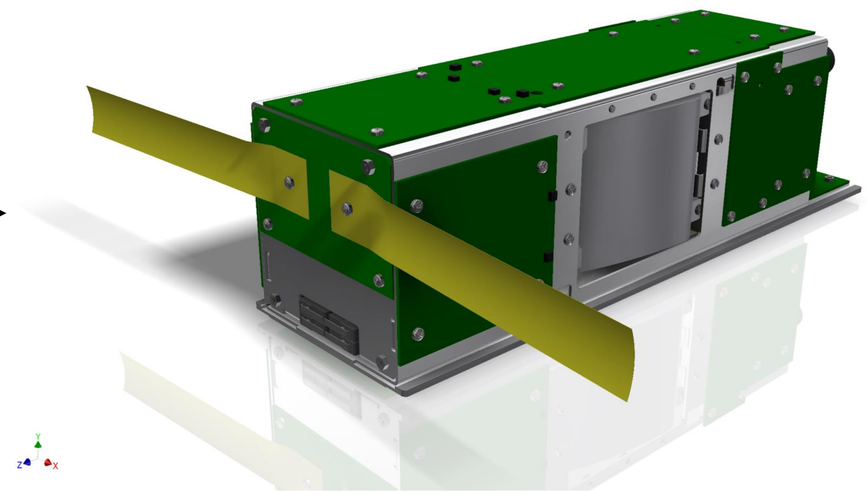
Autodesk Inventor is an all in one professional 3D CADD software package that provides an intelligent 3D modeling workspace as well as simulation, design visualization, and drafting tools. CACTUS-I's predicted mass distribution and center of gravity information was given to MATLAB for Passive Magnetic Attitude Control System (PMAC System) simulations. PCB sizes and requirements were given to Autodesk Eagle for electrical design.

The **SNAP** program (provided by Kentucky Space) developed on **MATLAB** allows the CACTUS-I team to determine spacecraft pointing and stability factors of the PMAC system.

AGI's STK is a very powerful mission planning and prediction software. Data from the SNAP simulations is imported into STK in order to predict ground tracks, pass and downlink times for operation.

Autodesk Eagle is a PCB layout and schematic tool with libraries of standard parts updated often by Autodesk and the Community. With mechanical requirements from Inventor and electrical requirements from other subsystems, designing a board in Eagle is very fast and easy. The board and parts can be transferred to Inventor to confirm the manufactured board will fit as desired.





CACTUS-I CubeSat visualized in Autodesk Inventor 2018

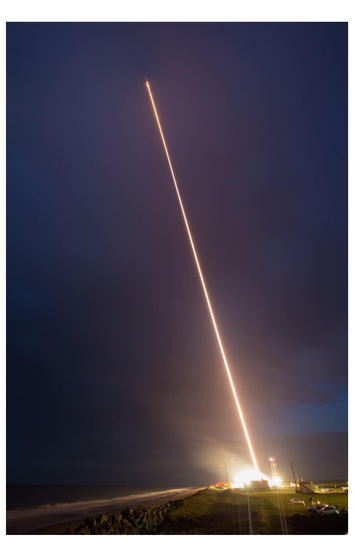


Photo credit: NASA Wallops

Future Missions:

CACTUS-I is the first CubeSat mission designed at Capitol Technology University. With the lessons learned and experience gained to design and build future CubeSats, documentation and testing data will serve as excellent reference material for future students of the University.

Capitol Technology University intends to eventually design and build more CubeSats to potentially remove low earth orbit (LEO) debris for future missions that intend to be stationed at LEO orbit. This same model could be used and integrated on various missions that may go beyond LEO.

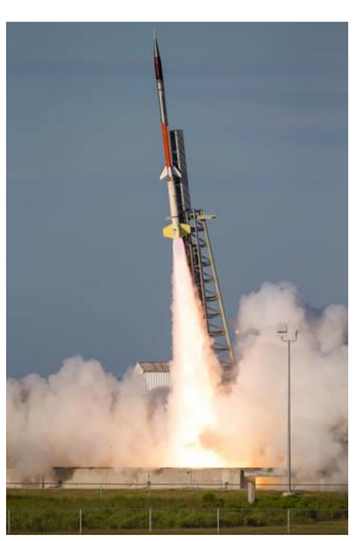


Photo Credit: NASA Wallops

Heritage:

CACTUS-I's components hold heritage from missions such as High Altitude Balloons and Sounding Rockets. Almost all of the systems within our CubeSat have flight heritage. Thus, allowing us to reduce costs during testing and to satisfy our mission. Capitol Technology University's Fusion Lab and Space Flight Operations and Training Center (SFOTC) host as incubators for multiple missions for CACTUS-I and many other missions.