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An Approach To Automated Control And Health Monitoring For Space Systems

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Presentation Plan

- Health monitoring and how it relates to modular and plug and play trends
- UCF current programs which are working on health monitoring projects

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What is Health Monitoring?

- Health monitoring is usually used to describe technologies which report status
- For the purposes of this lecture “Health Monitoring” is the following:
  - A set of technologies which will allow not only for a system to report its status but to detect faults in real-time and react by reconfiguring itself autonomously such that the problem is corrected
- UCF aims to develop a network of cooperative programs
  - Focusing on small satellite applications
  - Will allow the development of robust and fault tolerant systems

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Desired Health Monitoring Features

- Subsystems should have diagnostic, reporting, and reconfiguration capabilities built-in
- Should complement good design practice
  - Modular subsystem design
  - Assembled using a standardized communication bus
- Make use of existing standards
  - Prolong useful life
  - Allow upgrades

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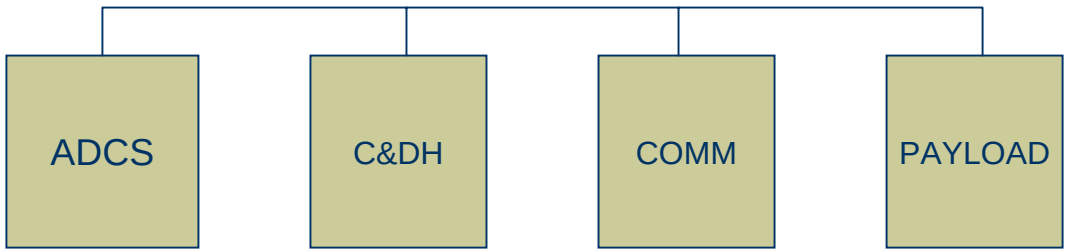
Health Monitoring Features

- Imagine system as a series of building blocks
  - Modules knows how to maintain themselves
  - Modules can communicate with others over the bus
- Fits ideally with Plug and Play concept!



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Health Monitoring Advantages

- Excellent complement to modular subsystem design
  - Adds intelligence to each module
  - Refines method in which systems communicate
  - Encourages elimination of unnecessary intersystem dependences
- Allows designer to add redundancy to system easily
- Enhanced robustness

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Health Monitoring Related Projects

- There are several tightly-coupled projects currently under development at UCF/FSI which are working with health monitoring technologies:
  - Micro-satellite design course (MODSAT)
  - Ground station program
  - Satellite control simulation effort
- This presentation will cover all of the above projects

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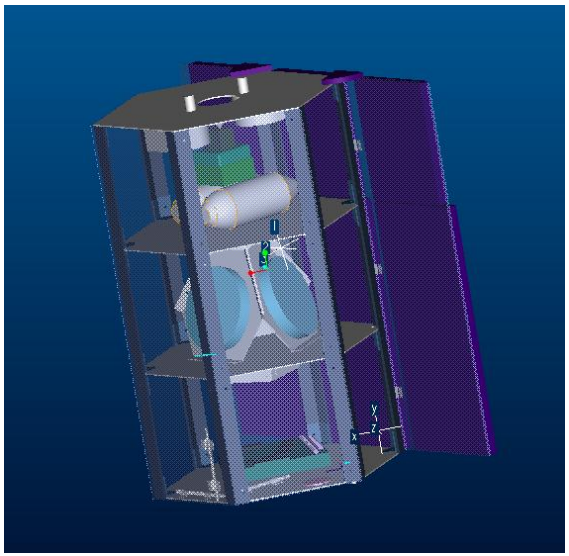
MODSAT Program



- The desired end result is a modular micro satellite which can carry a variety of payloads
  - Some of the payloads will be experimental C&DH systems which support advanced health monitoring features
  - Other payloads will include an experimental microwave electric thruster (MET)
- Early MODSAT series will be designed to test systems under development at UCF/FSI

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MODSAT Program

- The MODSAT program is comprised of an interdisciplinary design course and FSI research projects
  - Was created to address call for interdisciplinary design course from ABET and industry
  - Offered as a two semester sequence
  - Advised by graduate mentors and industry professionals and NASA/KSC

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MODSAT Program

- Interdisciplinary design
- Teams are assigned a satellite subsystem to complete
  - Teams are given “hard-requirements” for system functions and health monitoring
  - Coordinate with other sub-teams to design compatible subsystems with health monitoring capability
- Emphasis is placed on using available technology and standards where available
  - Helps speed development
  - Lowers cost

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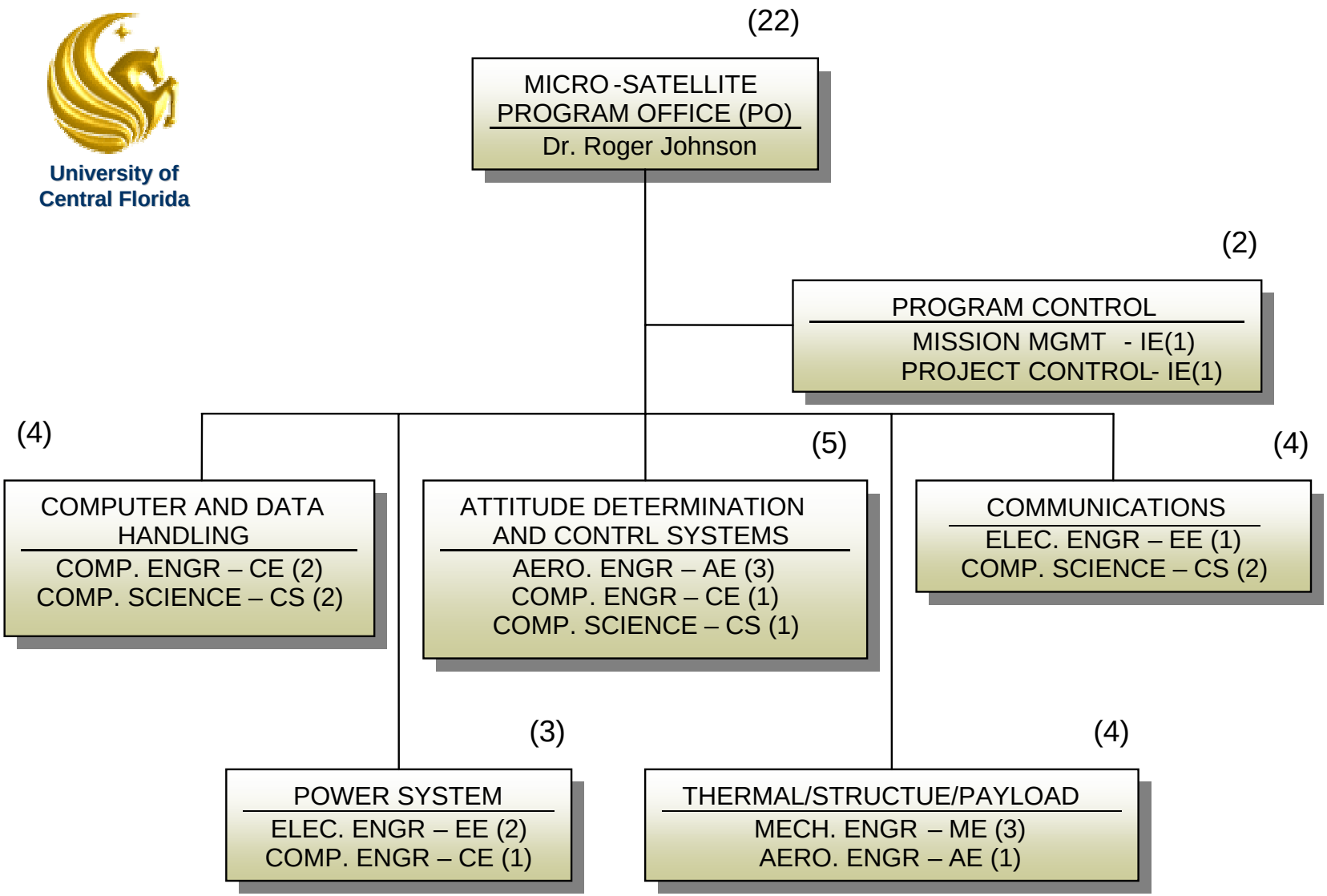

Figure 1 – AY2003-2004, Example Organization

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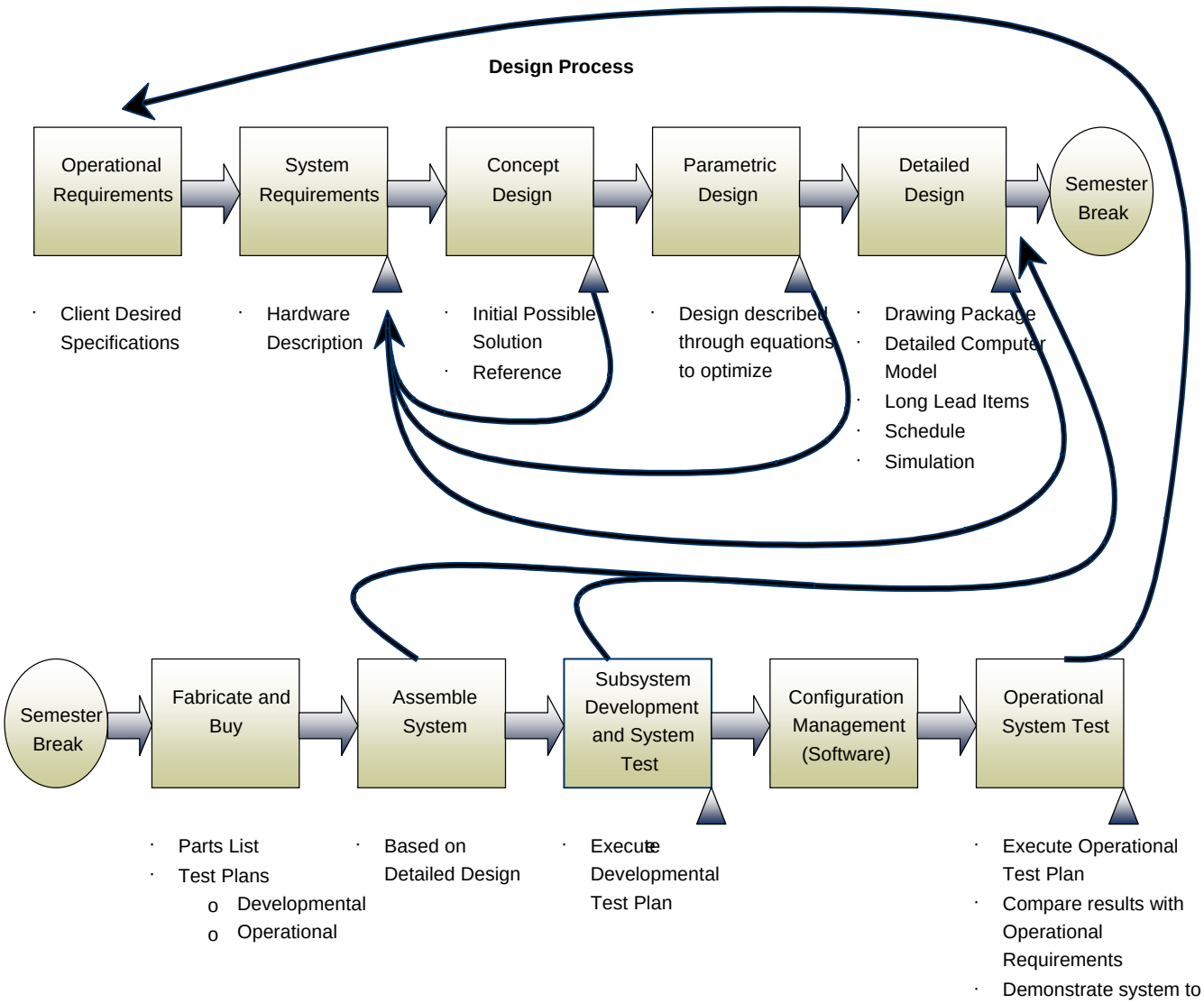

Figure 2 – Design Process

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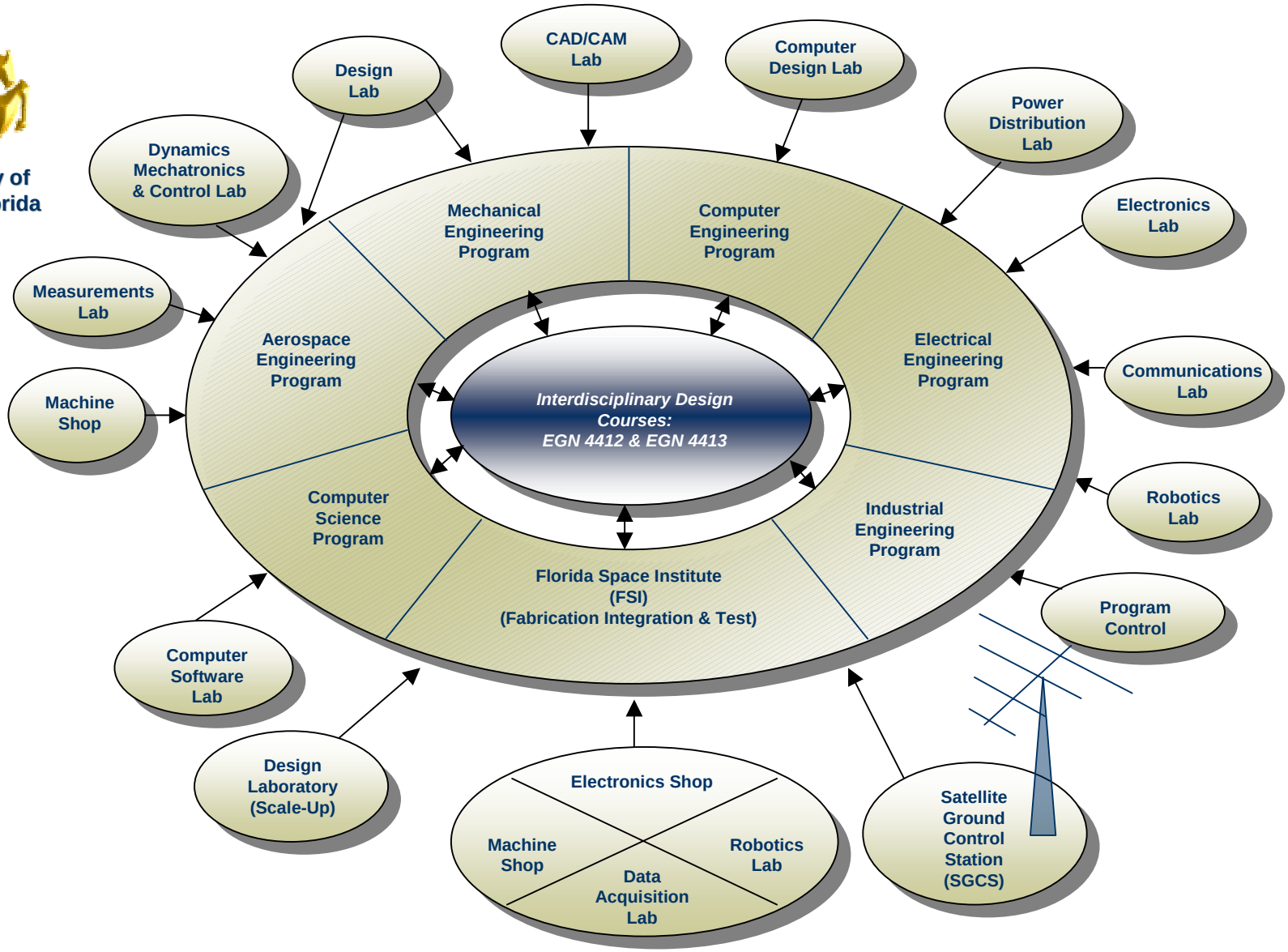

Figure 3 – Department Support

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Satellite Ground Control Station

- The desired end result of this project is to automate tracking and control of UCF's satellites in orbit
- System currently under construction, aiming at completion within the year
- SGCS composition:
  - Data storage unit (SGI Origin Series) located at the Florida Space Authority tied into telemetry backbone
  - Primary antenna and decoding unit (SGI Octane Series) located at SPACEHAB

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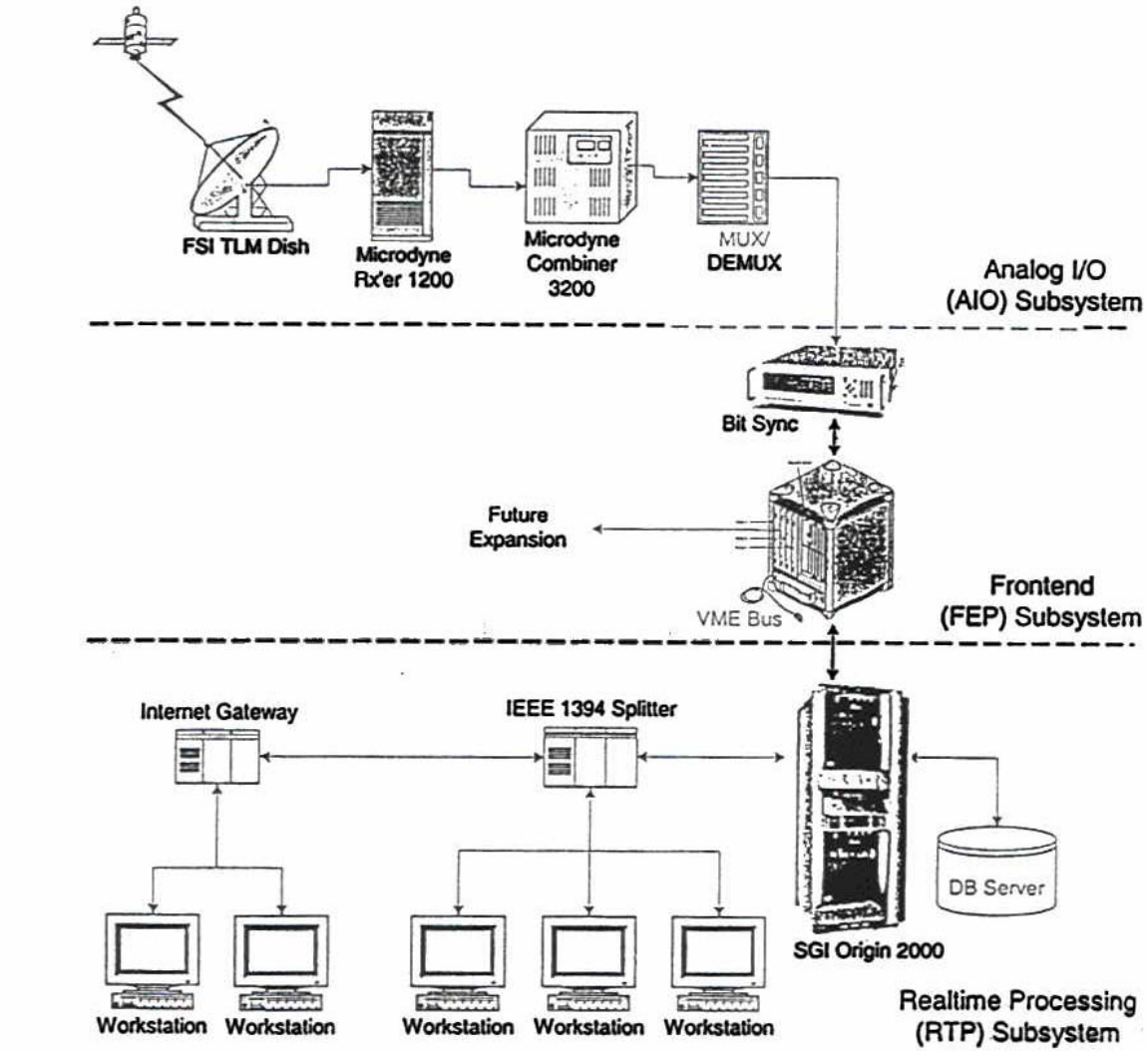

Figure 9 – Ground Station Configuration

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Satellite Simulator Effort

- Original mission was to assist ground station project
  - Grew to include objectives from other program
  - Will aid in building health monitoring technologies
  - Planned to be used as a teaching tool
- Current objective is to provide complete simulation of satellite control system and ground station

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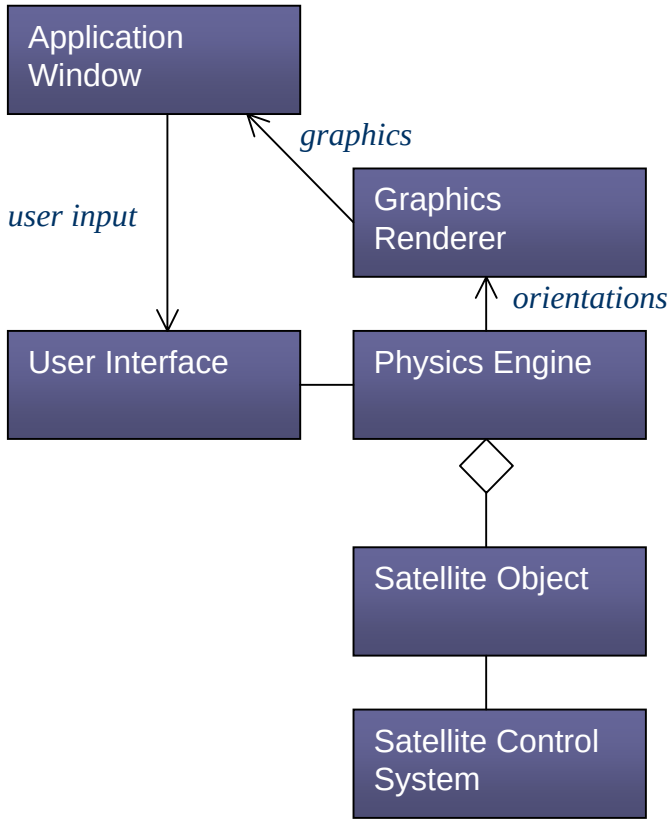
Simulator Structure



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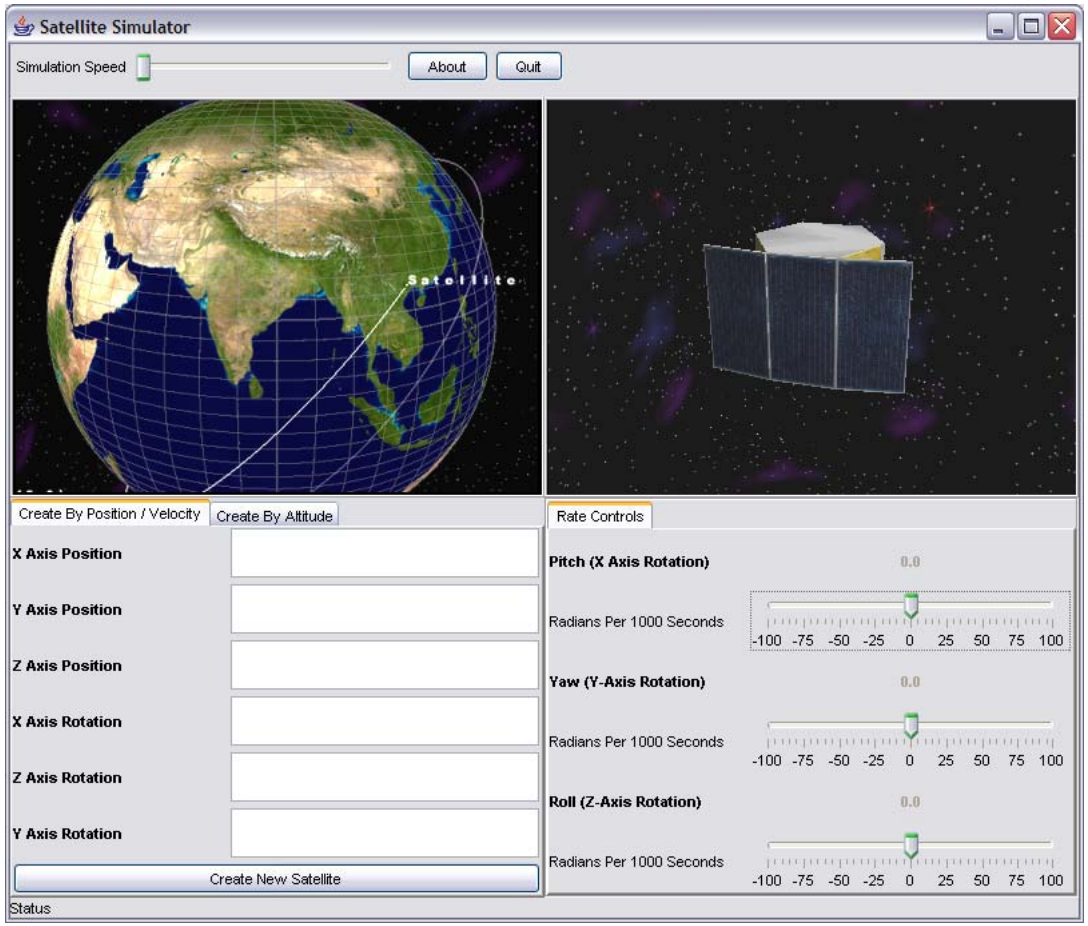
Simulator Example View