Project Name: SCENARIO

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Introduction: In the development of an orbital satellite, it is sometimes necessary to include one or more moving parts in the design. However, as there is no friction or drag in space, any movement in the robot will cause a change in attitude and position. The SCENARIO project, Simulated Control ENvironment for Active Robots In Orbit, intends to simulate the free-floating behavior an orbital robot will experience in space. This project is centered around the development of a planar, three degree of freedom system, which will serve as a proof of concept for future projects with higher degrees of freedom. The system will contain the following subsystems:

Robotic Platform
The Robotic Platform will contain the 3-DOF planar manipulator necessary to move the planar space robot through all necessary poses during the simulation.

Data Acquisition
The Data Acquisition system will gather all sensor data at a high frequency for use in the Software subsystem.

Software
The Software subsystem will contain the control law and the user interface for the machine. The control law will regulate the motors of the Robotic Platform.

Planar Space Robot
The Planar Space Robot subsystem will move independently of our Robotic Platform, and will represent an experimental space robot in its design cycle.

Design Requirements:

1. Robotic Platform

1.1. The Robotic Platform system shall simulate free-floating movement for the Planar Space Robot.
The Planar Space Robot shall move as if on a frictionless surface. The Planar Space Robot should not be able to observe external forces such as friction and drag. It is the task of the Robotic Platform to simulate this movement.

1.2. The Robotic Platform system shall include a CR-H2010 series Hirata manipulator.
The HIRATA has been purchased and allocated for this project. It is capable of manipulating a load in a three degree of freedom workspace.

1.3. The Robotic Platform system shall operate in a three degree of freedom environment.
The Planar Space Robot should be allowed to move in two orthogonal linear directions with respect to the Robotic Platform. The Planar Space Robot should be allowed to rotate about a third axis, orthogonal to its axes of movement.

1.4. The Robotic Platform system shall be actuated by three 250W Maxon RE65 DC motors and encoded by three Avago HEDS 5540 A15 encoders.
These motors and encoders have been purchased and allocated for this project.

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[1] Design Team Chair
[2] Software Design
[3] Mechanical Design
[4] Electrical Design
[5] Electrical Design

2. Data Acquisition

    2.1. The Data Acquisition system shall have the ability to send recorded encoder values, forces, and torques from sensors to a computer.
    The Data Acquisition system will retrieve data from sensors and send them to a computer where it will be processed and used for control.

    2.2. The Data Acquisition system shall acquire data from the sensors at the highest possible frequency.
    The sensor data must be retrieved at a high enough frequency for controlled movement of the links.

    2.3. The Data Acquisition system shall use an ATI Mini-40 torque-force sensor to observe torques and forces on the planar space robot.
    To properly simulate a free-floating environment, the use of a torque-force sensor will be required to measure the external and internal forces acting on and within the Planar Space Robot. This sensor has been purchased and allocated to this project.

    2.4. A motion capture system shall be used to record the task-space coordinates of the Planar Space Robot while it is on the air bearing table.
    For system verification, it is necessary to compare our experimental system with an already-validated system. A motion capture system will allow for accurate tracking and recording the task space coordinates of the Planar Space Robot's motion on the low-friction air bearing table.

3. Software

    3.1. The Robotic Platform system shall have a control system that replicates free floating motion.
    To simulate free-floating movement, each degree of freedom will need to be controlled. The output of each motor and particular sensors should be used in a feedback loop to control motor input. The control will be achieved in the Software subsystem using sensor information from the Data Acquisition system.

    3.2. The system shall have a user interface to move the Planar Space Robot and set experimental parameters.
    To be useful as a tool for simulation, the user should be able to specify an experimental duration and other test parameters for the system. In addition, the user should have the ability to send movement commands to the Planar Space Robot via the software interface.

4. Planar Space Robot

    4.1. The Planar Space Robot system shall consist of two discrete Planar Space Robots which have identical dynamic properties.
    These two robots will be identical in mass and distribution of mass. They will have the same actuators and will behave in the same way given the same system inputs. Each will be mountable to the Robotic Platform.

    4.2. The Planar Space Robot system shall include a minimum of four physical links.
    The system should be complex enough to excite the torque-force sensor, and provide useful experimental data.

    4.3. The Planar Space Robot system shall have an actuator for attitude control.
    The addition of a spinning disc to the Planar Space Robot allows the robot to regulate its own orientation. The disc adds an additional degree of freedom to the Planar Space Robot and further excites the torque-force sensor.

4.4. The Planar Space Robot system shall use an on-board battery to power its on-board electronics.
The system must accurately recreate the conditions the Planar Space Robot would experience in an orbital scenario. Cables leading from the Planar Space Robot would introduce external forces.

4.5. The Planar Space Robot system shall have wireless communication capability with the PC workstation.
The system must accurately recreate the conditions the Planar Space Robot would experience in an orbit scenario. Cables leading from the Planar Space Robot would introduce external forces.

4.6. The Planar Space Robot system shall consist of at least one robot with functional air bearings.
At least one Planar Space Robot will be placed on the air bearing table, and fitted with air bearings to simulate a frictionless environment. In order to make the air bearings function, the Planar Space Robot will also require a compressed air tank, regulator, and air tubes to feed the air bearings.

Attributions:

Tasks	Team Members				
	Andy Worthington	Tym Anderson	Lorenzo Lucchese	Maddy Markham	Lucas Vasconcelos
Team Logo			X		
Introduction			X	X	
Robotic Platform	X	X		X	
Data Acquisition	X	X		X	
Software	X				X
Planar Space Robot (PSR)	X	X	X	X	
Planar Space Robot (PSR) #2	X	X	X	X	X
Presentation		X			X
Formatting			X		
Editing	X	X	X	X	X
Attributions	X	X	X	X	X
Revisions	X	X	X	X	X