

Astrobee System Overview

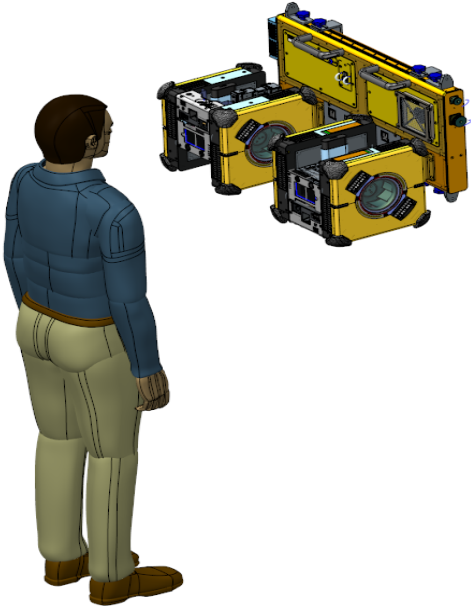
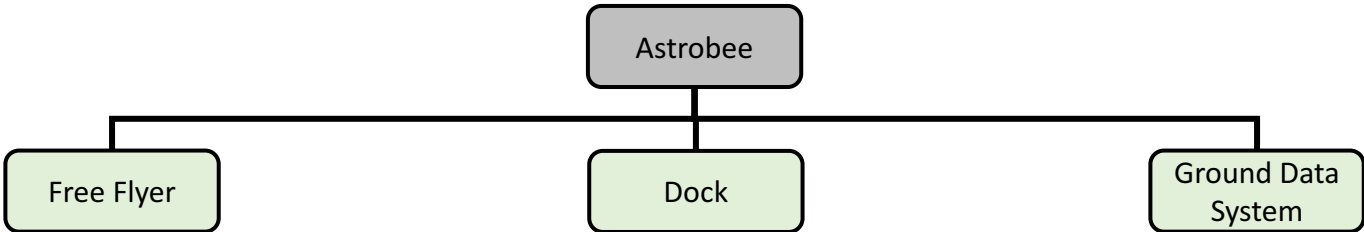


POIWG #41 Astrobee Splinter

April 25, 2017

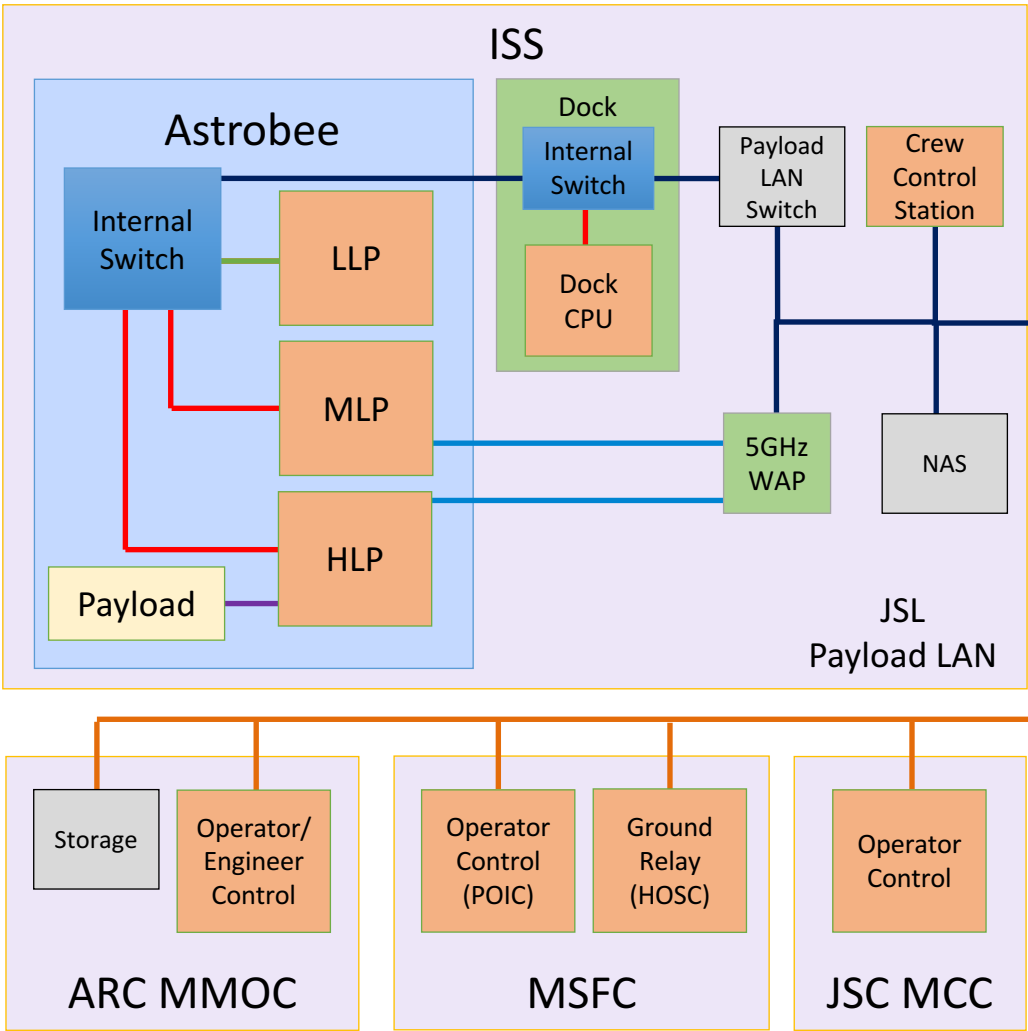


Astrobee Elements





System Data Flow Diagram

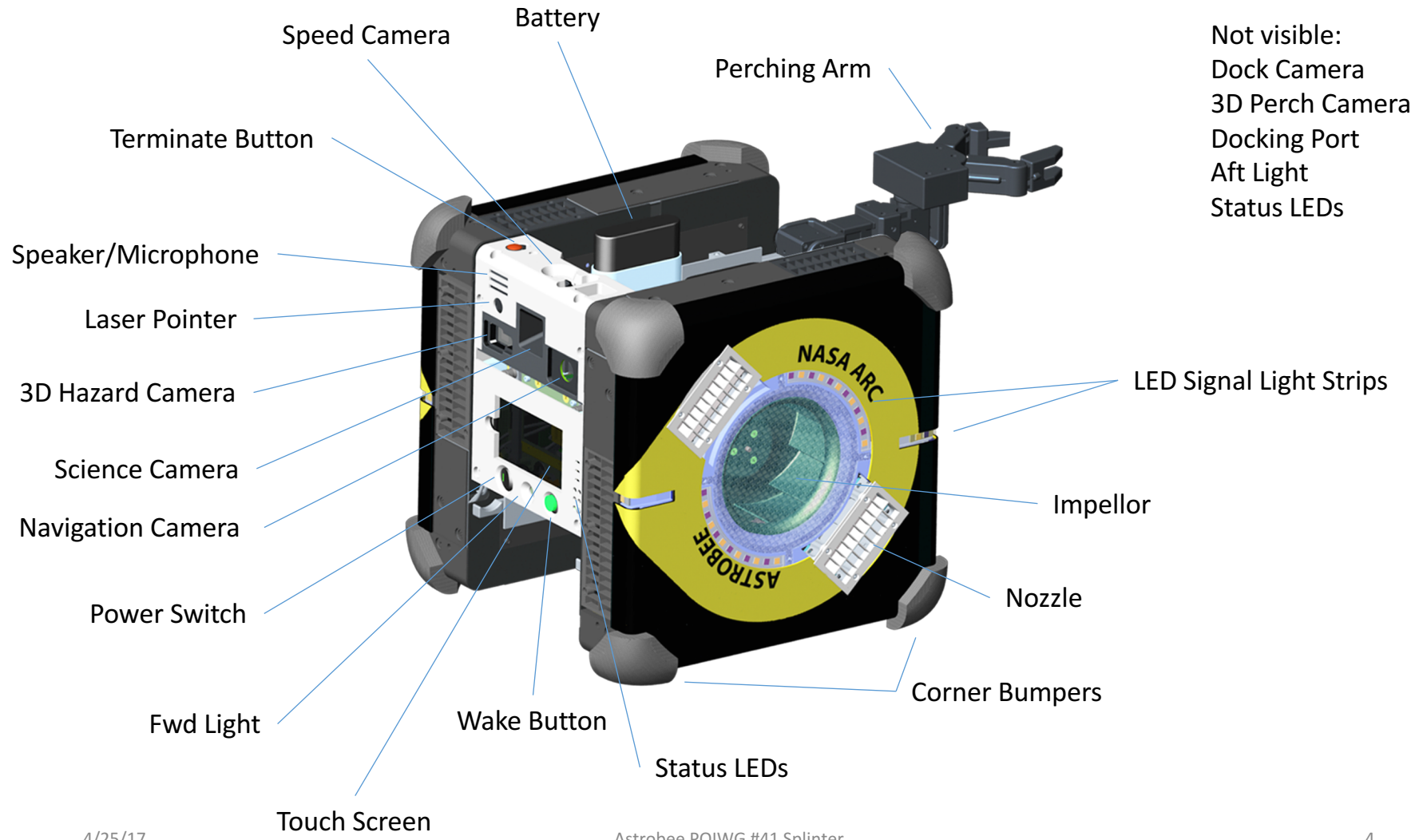


Link Legend

- Ethernet/LAN —
- Ethernet: Internal IP —
- Ethernet: Internal and Payload LAN —
- WiFi: Payload LAN —
- USB —
- Other/LAN —



Astrobee

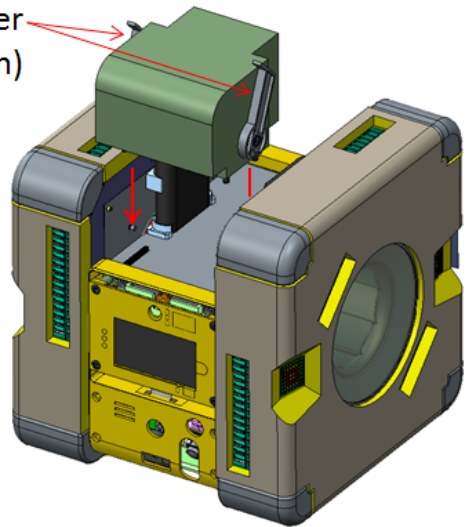




Payload Attachment Options

Quick "No Tool" Payload Attachment

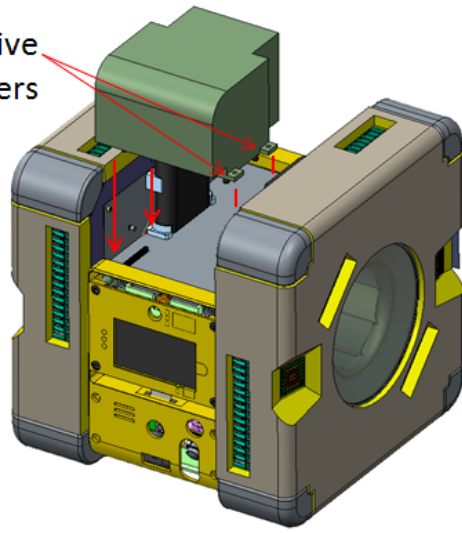
2X Lever
(open position)



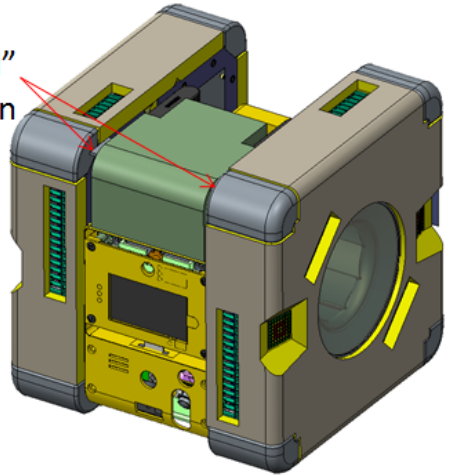
Lever engages and disengages payload connector and provides mechanical attachment

4X Fastener Payload Attachment

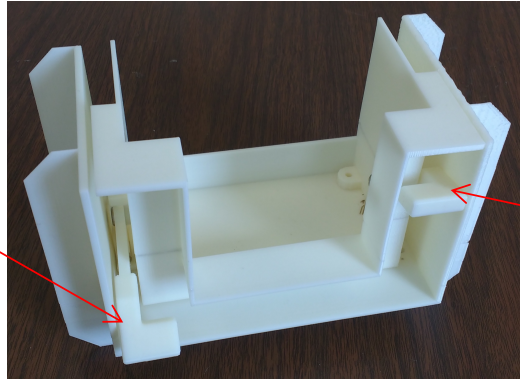
4X Captive Fasteners



Lever in "Locked" position



"Un-Lock" Position

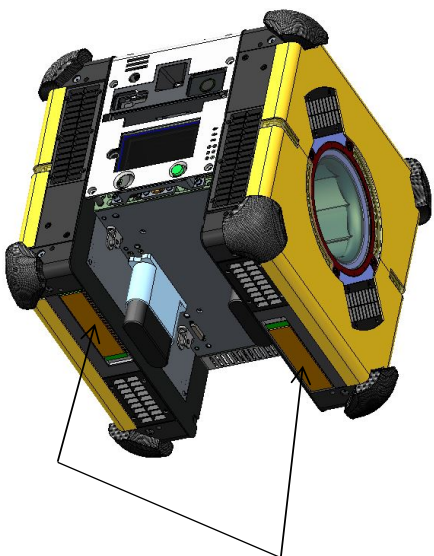


"Lock" Position

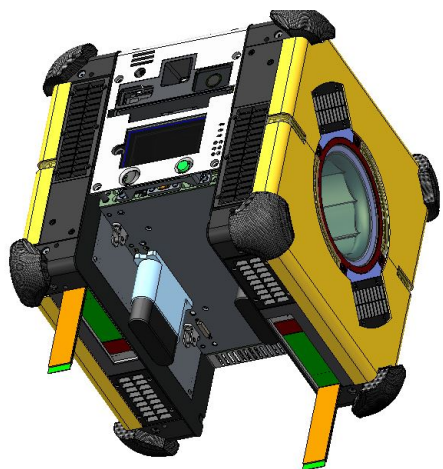


Restraint Straps

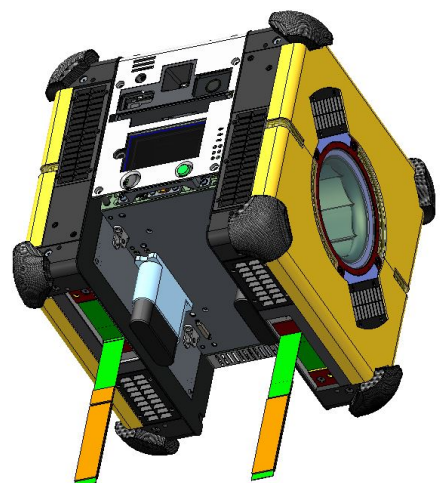
Strap with Velcro hook allows Astrobee to be restrained to ISS loop patches



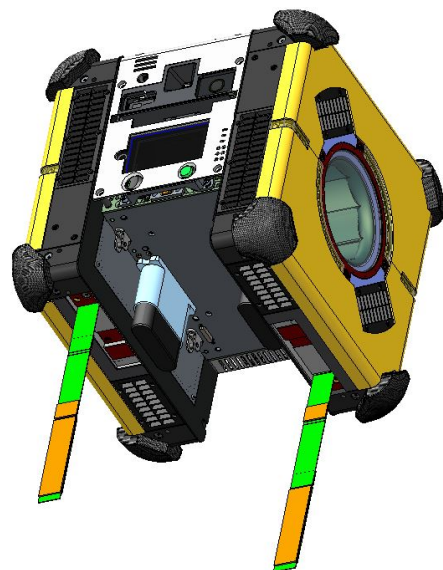
Two deployable straps for restraining Astrobee on station. Velcro Hook on ends of straps



Strap is unfolded 1 fold



Strap is unfolded 2 folds



Fully Deployed ~ 10" Strap



Dock

Air Vent Deflector

Subsystem Breakers

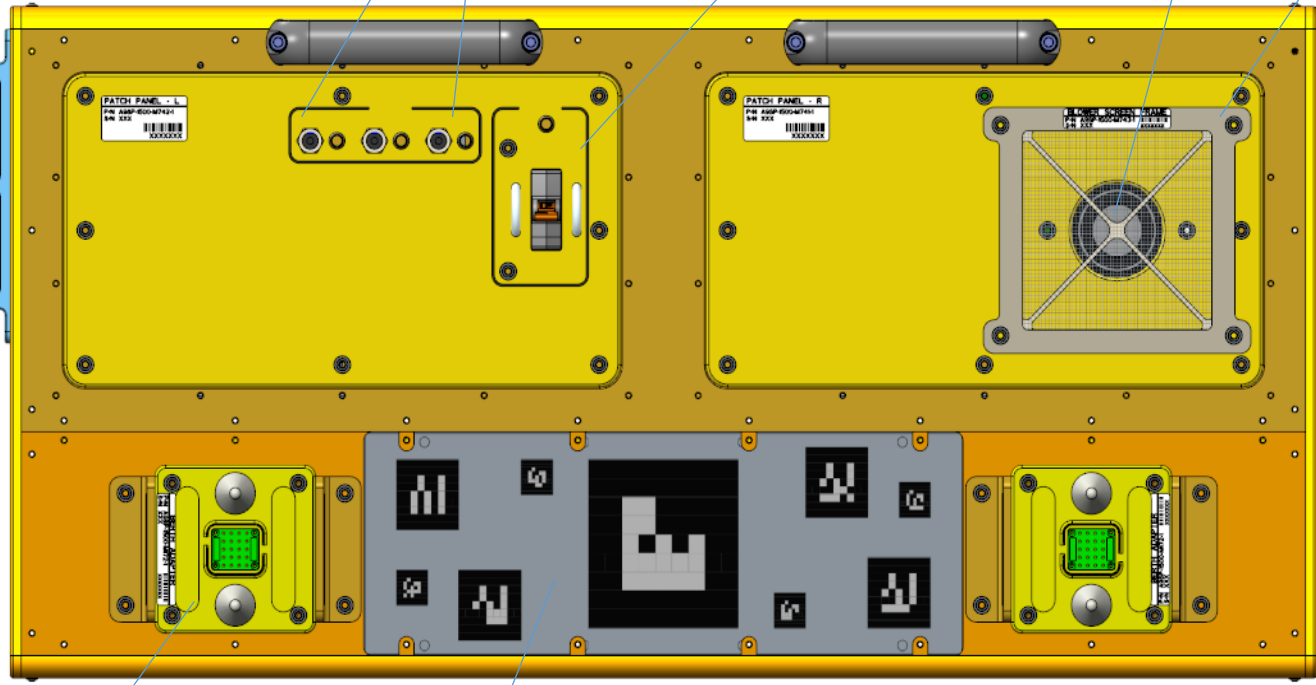
Main Power Breaker

Cooling Fan

Cooling Fan Screen

RJ-45 Connector

Power Connector



Free Flyer Berth

AR Target



Run Plan Tab

File Edit View Help

Run Plan | Teleoperation | Guest Science

FreeFlyerA Comm ● Control DW@DW-Windows7-32 Batt 84 Docking Station ● GPS 11Jan17 18:20:23

Health and Status Details

Operating State	Plan Execution
Mobility State	Flying
Operating Limits	Default_Safeguard
Plan	ExamplePlan
Plan Status	Executing

Initialization

Wake

Grab Control

Robot Commanding

File ... C:\Users\DW\Desktop\FPla

Plan Valid

Load Run Pause Skip Step

Description

A plan that goes in a spiral.

Select and upload Plan, and control Plan execution

Plan

Total Elapsed Time 00:00:43

Plan Step	Duration	Success
ExamplePlan		
0 Station		Complete
0-1 Segment	00:01:30	Complete
1 Station		Complete
1-2 Segment	00:01:30	Complete
2 Station		Complete
2-3 Segment		
3 Station		
3-4 Segment		
4 Station		
4-5 Segment		
5 Station		

Monitor plan execution

Live Telemetry | Live Images | Science Camera

Model of loaded plan

Reset View

Center on Bee

Astrobee POIWG #41 Splinter



Teleoperation Tab

Construct and send movement commands

File Edit View Help

Run Plan Teleoperation Guest Science

FreeFlyerA Comm ● Control DW@DW-Windows7-32 Batt 87 Docking Station ● GPS 12Jan17 01:46:27

Health and Status	
Operating State	Ready
Mobility State	Stopped
Operating Limits	Default_Safeguard
Plan	
Plan Status	Idle

Manual Commanding Perching Arm Docking

Initialization Manual Inputs Reset Inputs

Wake Grab Control No Bookmark Selected

Aft Fwd Roll

Port Stbd Pitch

Ovhd Deck Yaw

Options Commands

Allow Lateral Motion Move

Override Obstacles Stop

Override Keepouts

Configurable Teleop Commands

Gripper Open

Idle Propulsion Idle

Payload A On

Flashlight Brightness

Front Set

Data Type Action

Immediate Send

Live Telemetry Live Images Live Video

LAB1S1 LAB1S2 LAB1S3 LAB1S4 LAB1S5

LAB1D1 LAB1D2 LAB1D3 LAB1D4

Astrobee POIWG #41 Splinter

4/25/17

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Guest Science Tab

Crew Control Station

File Edit View Help

Run Plan Teleoperation Guest Science

Docking Station ● GPS 17Jan17 18:44:47

Astrobee Selection and Status

Control	Batt	Summary	Plan	Plan Status	Health
<input type="checkbox"/> FreeFlyerA	nobody			Idle	●
<input checked="" type="checkbox"/> FreeFlyerB	DW@DW-Windows7-32			Idle	●
<input type="checkbox"/> FreeFlyerC					●

Commanding for FreeFlyerB

Wake Grab Control

Plans

Load

Run Stop

Manual Commanding

Guest Science Command

Send Command

4/25/17

18:41:36 FreeFlyerB: Grab Control

Live Telemetry Live Images Science Camera

Monitor Astrobee positions in 3D window

Astrobee POIWG #41 Splinter

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Checkboxes select Astrobees to command

Status summaries

Names of loaded Plans

Command Astrobees



ISS Commissioning Activities

- Planned Activities:

- Installation
- Comm Checks
- Component Checkouts
- Initial Mapping
- Basic Mobility
- Autonomous Mobility
- Crew Interface Checkout
- Incremental Mapping – no crew needed
- Astrobee “B” and “C” Commissioning
- Demonstration – no crew needed other than payload installation in advance of demo



Initial Mapping Activity

- Example of an activity explicitly involving crew

Component Activites/Tests	Description
Setup	Astrobee engineering prepares free flyer for activity (wakes, initializes system, etc.)
AR Localization Test	Crew physically “flies” the robot around in the vicinity of the dock to test AR target localization
Crew mapping	Crew physically “flies” the robot around in the module containing the dock to collect initial map data
Shutdown	Astrobee engineering downlinks files and shuts down the free flyer



Autonomous Mobility Activity

- Example of an activity that does not explicitly involving crew for the entire duration

Component Activites/Tests	Description
Setup	Astrobee engineering prepares free flyer for activity (wakes, initializes system, etc.)
Demonstrate autonomous undock/dock	Crew manually places robot in 4 initial positions for docking tests
Demonstrate complex trajectory	Astrobee engineering commands the free flyer to fly one simple, one moderate, and one challenging trajectory
Demonstrate autonomous perching	Astrobee engineering commands the free flyer to fly to a perch location and perch
Demonstrate pan/tilt	Astrobee engineering commands the free flyer to pan and tilt while perched
Shutdown	Astrobee engineering returns the free flyer to the dock, downlinks files and shuts down the free flyer