



System Integration, Test & Launch Engineering Internship

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Honors College, Oregon State University

21 Aug 2019

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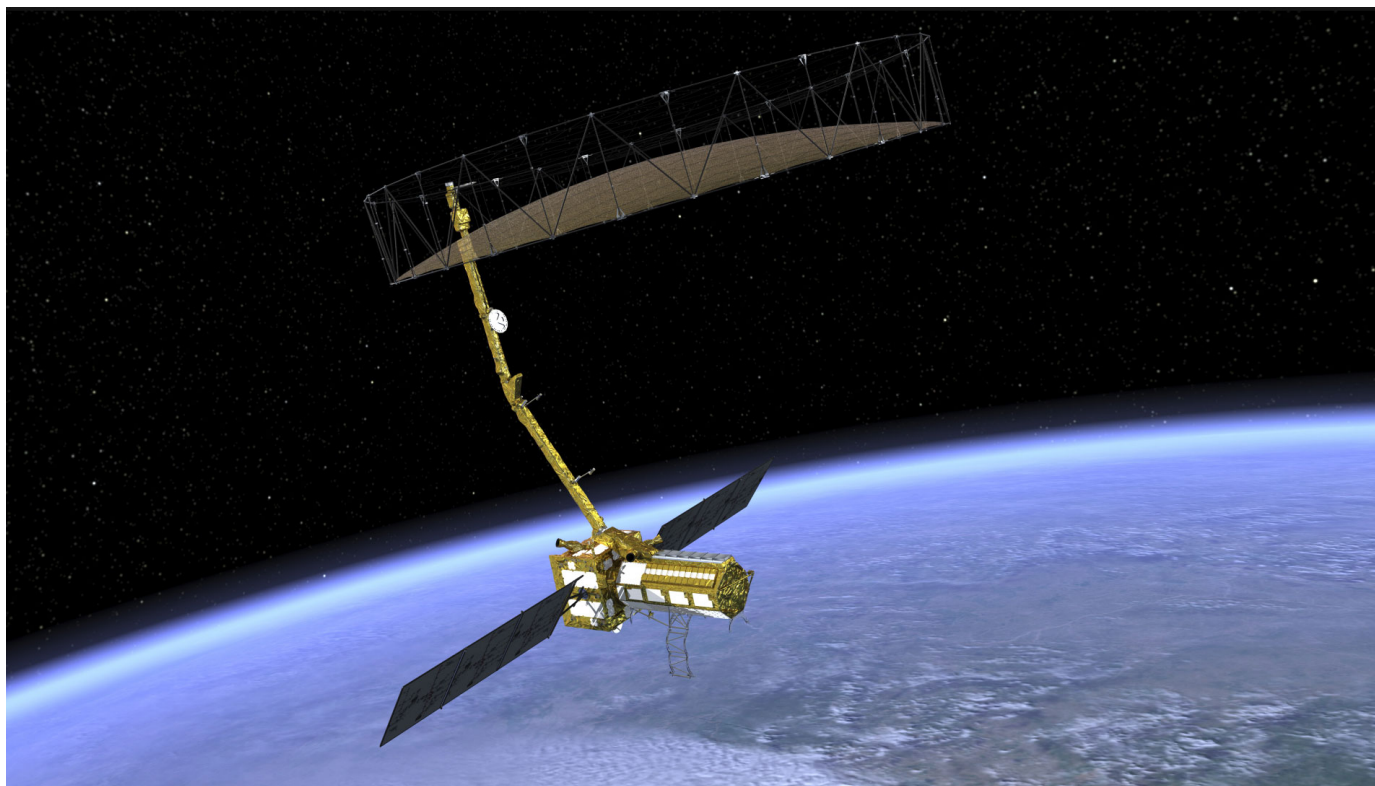
- Oregon State University
 - Honors Bachelor of Science
 - Computer Science Major, Applied option with an intended focus on Robotic Intelligence
 - Graduating June 2022
 - Oregon State University Men's Lacrosse Club





NISAR (NASA ISRO Synthetic Aperture Radar)

- Systems Integration, Test & Launch Operations, Group 313B



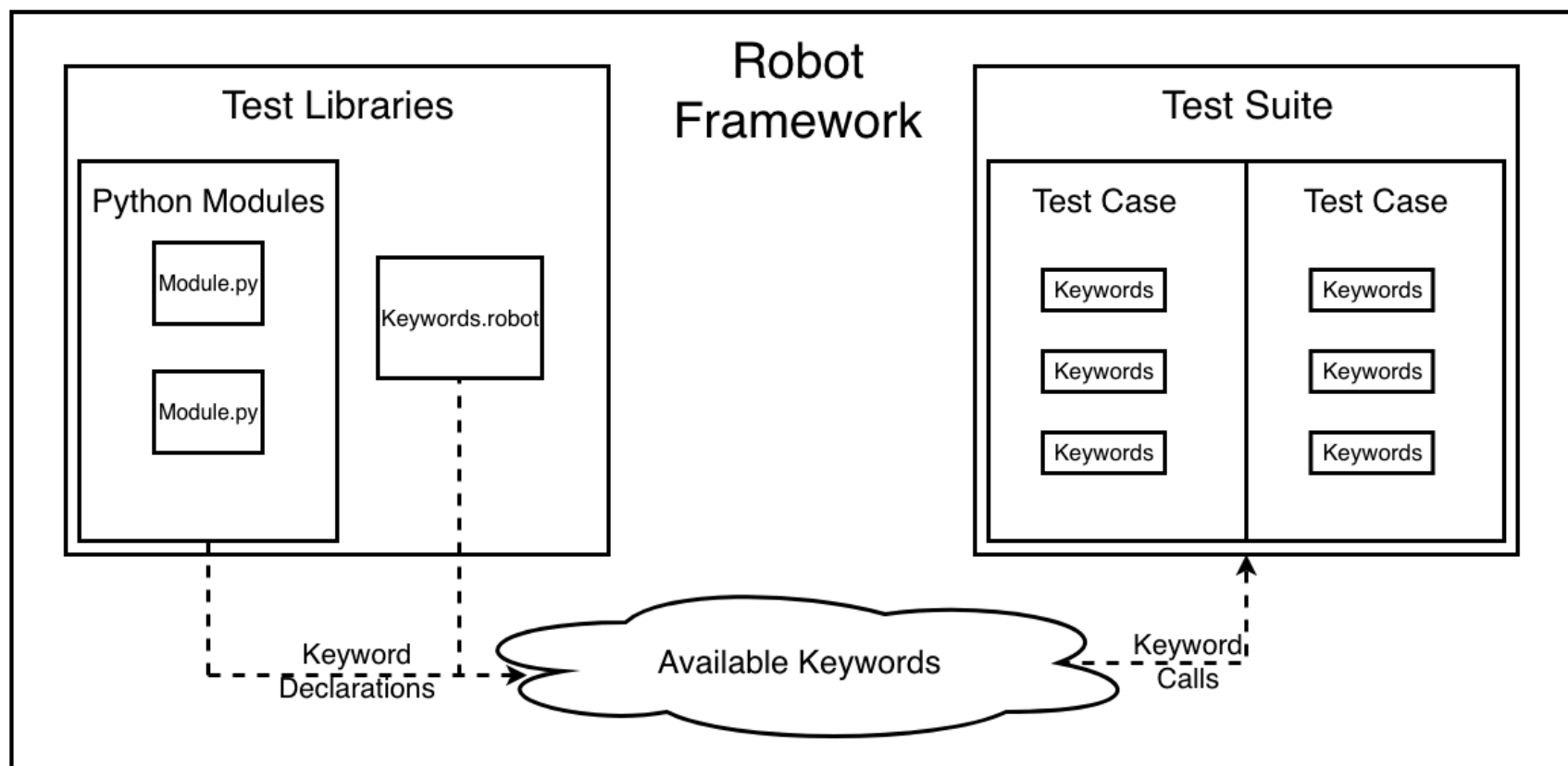
Jet Propulsion Laboratory
California Institute of Technology



- Test automation with Robot Framework
- 306 Hi-bay cable management & application development
- Smaller projects:
 - Scripting
 - NISAR SIT 3/4 wiki page development

Robot Framework Background

- Keyword-based test automation framework (Python)
 - Allows for automated procedure execution
 - Allows access to powerful software libraries without extensive programming knowledge



Drawing created by
Nick Zhao, Intern

Implementation on Workstation Test Set

- WSTS
 - Benefits: Test reporting, output.xml file – important.

TEST1 Log

Generated
20190723 20:58:56 UTC+00:00
13 days 1 hour ago

REPORT

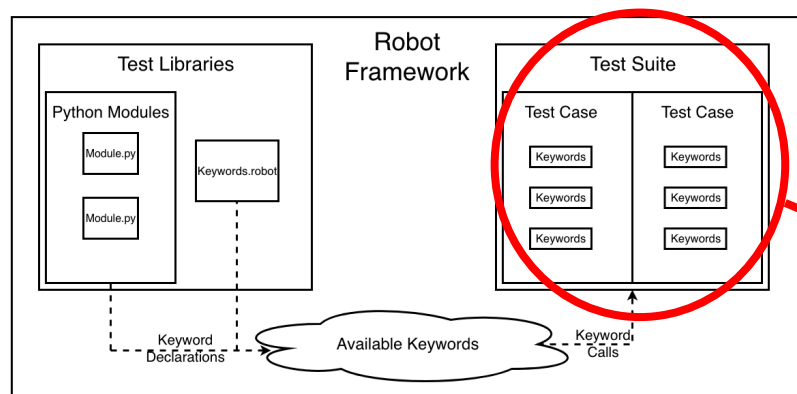
Test Statistics

Total Statistics	Total	Pass	Fail	Elapsed	Pass / Fail
Critical Tests	6	5	1	00:08:54	<div><div></div></div>
All Tests	6	5	1	00:08:54	<div><div></div></div>
Statistics by Tag	Total	Pass	Fail	Elapsed	Pass / Fail
station-sys	5	4	1	00:08:37	<div><div></div></div>
Statistics by Suite	Total	Pass	Fail	Elapsed	Pass / Fail
TEST1	6	5	1	00:08:55	<div><div></div></div>
TEST1.01 Wsts Start	3	3	0	00:06:12	<div><div></div></div>
TEST1.02 Setup and Init	3	2	1	00:02:43	<div><div></div></div>

Test Execution Log

<div>SUITE</div> TEST1 Full Name: TEST1 Source: /home/nzhao/Documents/robot_framework/Tests/TEST1 Start / End / Elapsed: 20190723 20:50:01.248 / 20190723 20:58:56.637 / 00:08:55.389 Status: 6 critical test, 5 passed, 1 failed 6 test total, 5 passed, 1 failed	00:08:55.389
<div>SUITE</div> 01 Wsts Start <div>SUITE</div> 02 Setup and Init Full Name: TEST1.02 Setup and Init Documentation: Sends commands to VxWorks, waits for user input to power on and configure the SSR. Source: /home/nzhao/Documents/robot_framework/Tests/TEST1/02_Setup_and_Init.robot Start / End / Elapsed: 20190723 20:56:13.698 / 20190723 20:58:56.635 / 00:02:42.937 Status: 3 critical test, 2 passed, 1 failed 3 test total, 2 passed, 1 failed	00:06:12.427
<div>TEST</div> Initialize MTAK Connection	00:00:16.638
<div>TEST</div> Send VxWorks Commands	00:00:20.201
<div>TEST</div> Configure SSR Full Name: TEST1.02 Setup and Init.Configure SSR Documentation: Configures the SSR Tags: station-sys Start / End / Elapsed: 20190723 20:56:50.553 / 20190723 20:58:56.634 / 00:02:06.081 Status: FAIL (critical)	00:02:06.081

Example Robot Test Suite



```

1  ***Settings***
2  Library    Process
3  Resource   ../Libraries/Keywords.robot
4
5  ***Test Cases***
6
7  Start WSTS
8  |...Start WSTS
9
10 Wait until Cutecom is detected to be running
11 |...Wait Until Cutecom is Running
12
13 Wait until the "FILES Sync all done" EVR appears in Cutecom
14 |...Wait Until Files Have Synced
15
16 Initialize MTAK Connection
17 |...Import ATLORobotLibrary
18
19 Send Test Command to Cutecom
20 |...Send Command VxWorks A Hello World
21
22 Close WSTS
23 |...Close WSTS
24

```

What is Suite-to-docx?

```

1 *** Settings ***
2 Documentation    Performs the checkout of the Digital Sun Sensor Assembly-A
3 ...              (DSA-A)
4
5 Metadata         Author    Robert Castillo (rcastill@jpl.nasa.gov)
6 Library          Remote    http://127.0.0.1:9000
7
8 *** Test Cases ***
9 Record system state before DSA-A power on
10 ... [Tags] station-sys
11 ... Verify EHA    PWR-5253    PWR-CA2-20-ACT-DSA_A_Power    OFF    STATUS
12
13 Send command to power on the DSA-A
14 ... [Tags] station-cmd
15 ... Send Command AMPCS    A    ACS_DSA_POWER,A,ON
16 ... # Injection is TESTSET only
17 ... Verify EHA    PWR-5253    PWR-CA2-20-ACT-DSA_A_Power    ON    STATUS
18 ... Verify EHA    ACS-0047    dsa_a_cmd_state    ON    STATUS
19
20 Send command configure the DSA-A to read from Head 1
21 ... [Tags] station-cmd
22 ... Send Command AMPCS    A    ACS_SET_DSA_MODE_MANUAL,A,H1
23 ... Verify EHA    ACS-0117    dsa_a_cmd_current_head    H1    STATUS
24 ... Verify EHA    ACS-0116    dsa_a_cmd_mode    MANUAL_MODE    STATUS
25 ... Verify EHA    ACS-5033    dsa_hd_sel    DSA_HEAD_1    STATUS
26 ... Verify EHA    ACS-5034    dsa_hd_cmd    DSA_HEAD_1    STATUS
27 ... Verify EHA    ACS-5036    dsa_mode    COMP_MODE    STATUS
28 ... Verify EHA    ACS-5037    dsa_pwr_sta    PWR_ON    STATUS
29
30 Send command to configure the DSA-A to AUTO Mode
31 ... [Tags] station-cmd
32 ... Send Command AMPCS    A    ACS_SET_DSA_MODE_AUTO,A
33 ... Verify EHA    ACS-0116    dsa_a_cmd_mode    AUTOMATIC_MODE    STATUS
34 ... Verify EHA    ACS-5036    dsa_mode    AUTO_MODE    STATUS
35 ... Verify EHA    ACS-5037    dsa_pwr_sta    PWR_ON    STATUS
36
37 Record system state before DSA-A power off
38 ... [Tags] station-cmd
39 ... Verify EHA    PWR-5253    PWR-CA2-20-ACT-DSA_A_Power    ON    STATUS
40
41 Send command to power off the DSA-A
42 ... [Tags] station-cmd
43 ... Send Command AMPCS    A    ACS_DSA_POWER,A,0
44 ... Verify EHA    PWR-5253    PWR-CA2-20-ACT-DSA_A_Power    OFF    STATUS

```

PBAT PXXXXX, Initial _____ / ____ / ____

<PROCEDURE_NAME> Procedure January 1, 2000

STEP	STATION	OPERATION	VERIFIED
6 M2020 DSA-A CHECKOUT			
Performs the checkout of the Digital Sun Sensor Assembly-A (DSA-A)			
6-1	SYS	Record system state before DSA-A power on	
		PWR-5253 PWR-CA2-20-ACT-DSA_A_Power _____ (OFF STATUS)	
6-2	CMD	Send command to power on the DSA-A	
AMPCS-A> ACS_DSA_POWER,A,ON			
		PWR-5253 PWR-CA2-20-ACT-DSA_A_Power _____ (ON STATUS)	
		ACS-0047 dsa_a_cmd_state _____ (ON STATUS)	
6-3	CMD	Send command configure the DSA-A to read from Head 1	
AMPCS-A> ACS_SET_DSA_MODE_MANUAL,A,H1			
		ACS-0117 dsa_a_cmd_current_head _____ (H1 STATUS)	
		ACS-0116 dsa_a_cmd_mode _____ (MANUAL_MODE STATUS)	
		ACS-5033 dsa_hd_sel _____ (DSA_HEAD_1 STATUS)	
		ACS-5034 dsa_hd_cmd _____ (DSA_HEAD_1 STATUS)	
		ACS-5036 dsa_mode _____ (COMP_MODE STATUS)	
		ACS-5037 dsa_pwr_sta _____ (PWR_ON STATUS)	
6-4	CMD	Send command to configure the DSA-A to AUTO Mode	
AMPCS-A> ACS_SET_DSA_MODE_AUTO,A			
		ACS-0116 dsa_a_cmd_mode _____ (AUTOMATIC_MODE STATUS)	
		ACS-5036 dsa_mode _____ (AUTO_MODE STATUS)	
		ACS-5037 dsa_pwr_sta _____ (PWR_ON STATUS)	
6-5	CMD	Record system state before DSA-A power off	
		PWR-5253 PWR-CA2-20-ACT-DSA_A_Power _____ (ON STATUS)	

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Legend:

Documentation

Station

Commands

Step-Station

Verify EHA

Suite-to-docx Capabilities

```

1 *** Settings ***
2 Documentation      A template test suit. Setup opens WSTS and spins until file sync is complete. Teardown closes WSTS.
3 Resource           ../Libraries/keywords.robot
4
5 *** Test Cases ***
6 Start WSTS
7 [tags]             station-cmd
8 #Documentation This is a
9 Start WSTS
10
11 Spin until Cutedcom Ready
12 [tags]             station-sys
13 [Documentation] Spin until Cutedcom becomes available
14 Wait for Cutedcom
15 Verify EVR Files Synced
16
17 Close WSTS
18 [tags]             station-cmd
19 Send Command       These arguments passed are hypenated last_word_is_connected_with_arrow-(antiquated_syntax)
20 [Documentation] This is how to put commands in using newer syntax, for example:
21 ...               *SSE Terminal> /m20sse/stb/bin/start_stb -recovermode*
22 Close WSTS
23 Capabilities Test
24 [tags]             station-txt
25 [Documentation] This section will change the description of the test in the documentation
26 ... You can add more lines with ..., and if you do not include documentation
27 ... (which is bad practice), this section is autofilled with the test name.
28 ... Also note sys/cmd are systems operations (read something/verify) and cmd
29 ... means command like connect to something, execute an operation, etc.
30 ...
31 ...
32 ... *CAUTION This creates a giant warning box that will show up on the document.*
33 ...
34 ... *WARNING This should also do something similar.*
35 ...
36 ... Line afterwards will still put inside box.
37 ...
38 ... *Note: This will create a bold line.
39 #Close WSTS

```

Without a [Documentation] flag, the only documentation for the test will be the test name.

The code below supports the functionality of "Send Command," however, this is not the same as documenting user instructions. To give user instructions, use the [Documentation] flag followed by *your text here* to bold a section (see output).

Note: the keywords "WARNING" and "CAUTION" will trigger a textbox when between asterisks.

1 TEMP TEST

A template test suit. Setup opens WSTS and spins until file sync is complete. Teardown closes WSTS.

Start WSTS

1-3 SYS Spin until Cutedcom becomes available

1-3 CMD This is how to put commands in using newer syntax, for example:

SSE Terminal> /m20sse/stb/bin/start_stb -recovermode

These-arguments-passed-are-hypenated> last_word_is_connected_with_arrow-(antiquated_syntax)

1-4 TXT This section will change the description of the test in the documentation You can add more lines with ..., and if you do not include documentation (which is bad practice), this section is autofilled with the test name. Also note sys/cmd are systems operations (read something/verify) and cmd means command like connect to something, execute an operation, etc.

CAUTION

This creates a giant warning box that will show up on the document.

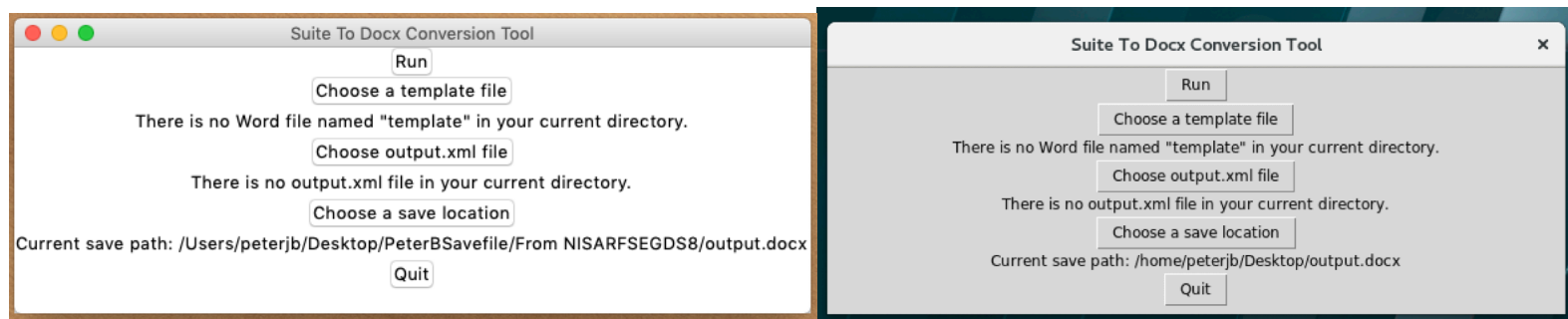
WARNING

This should also do something similar.

Line afterwards will still put inside box.

Note: This will create a bold line.

1. Took the Mars2020 code, updated it, and implemented it for NISAR
2. Instructing my team and others how to use it, and the potential benefits
3. Writing a Graphical User Interface (GUI)
4. Configuring Python Virtual Environments
5. Documentation



Shown: GUI for Suite to Docx

Manual vs. Automatically Generated

Initial Release
8 February 2019

JPL P13114
NISAR Mission Testbed Power ON/OFF Procedure

STEP	STATION	OPERATION	VERIFIED
------	---------	-----------	----------

5 MISSION TESTBED STARTUP PROCEDURE

If the racks are powered off refer to Appendix A (POWER SSE RACKS) to power on the racks.

5-1 GDS On the GDS SMAPFSWTBPCS1 workstation, open a new Terminal window and verify that "CommandBlockGen" is not running, by issuing the following command and observing that "CommandBlockGen" is not listed as one of the running java programs:

```
ps -ef | grep java
```

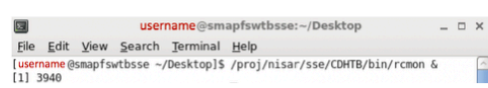
5-2 SSE On the SMAPFSWTBSSE workstation, open a new Terminal window and verify that "smapfswtbsse" is not running, by issuing the following command and observing that "smapfswtbsse" is not listed as one of the running python programs:

```
ps -ef | grep python
```

5.2 Initialize Simulation and Support Equipment (SSE)


5-3 SSE On the SMAPFSWTBSSE workstation, to monitor the racks before SSE software initialization, via the Terminal window, send:

```
/proj/nisar/sse/CDHTB/bin/rcmon &
```



The Rack Monitor window will pop up.

5-4 SSE In the Rack Monitor Window, verify that pc11 and pc21 (for Racks 1 and 2) are GREEN:



NOTE: SMAP had a third Rack, but NISAR does not. So, pc31 will stay red, as it is N/A.

5-5 SSE Via the Terminal window, send:

```
/proj/nisar/fsw/tools/bin/cutecom198 &
```

The CuteCom window will pop up:

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BPAT PXXXXX, Revision Initial
Base Template

August 12, 2019

STEP	STATION	OPERATION	VERIFIED
------	---------	-----------	----------

2 MISSION TESTBED STARTUP PROCEDURE

If the racks are powered off refer to Appendix A (POWER SSE RACKS) to power on the racks.

2.1 Setup

2-1 GDS On the GDS npdsdwnl workstation, open a new Terminal window and verify that "CommandBlockGen" is not running, by issuing the following command:

```
ps -ef | grep -i CommandBlockGen
```

NOTE: alternatively, ps -ef | grep java would show the user all of the running java applications...

2-2 SSE On the SMAPFSWTBSSE workstation, open a new Terminal window and verify that "smapfswtbsse" is not running, by issuing the following command:

```
ps -ef | grep python | grep smapfswtbsse
```

NOTE: alternatively, ps -ef | grep python would show the user all of the running python applications...

2.2 Initialize Simulation and Support Equipment(SSE)

2-3 SSE On the SMAPFSWTBSSE workstation, to monitor the racks before SSE software initialization, via the Terminal window, send:

```
/proj/nisar/sse/CDHTB/bin/rcmon &
```

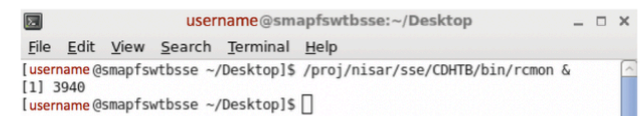



Figure 1-1: image one caption

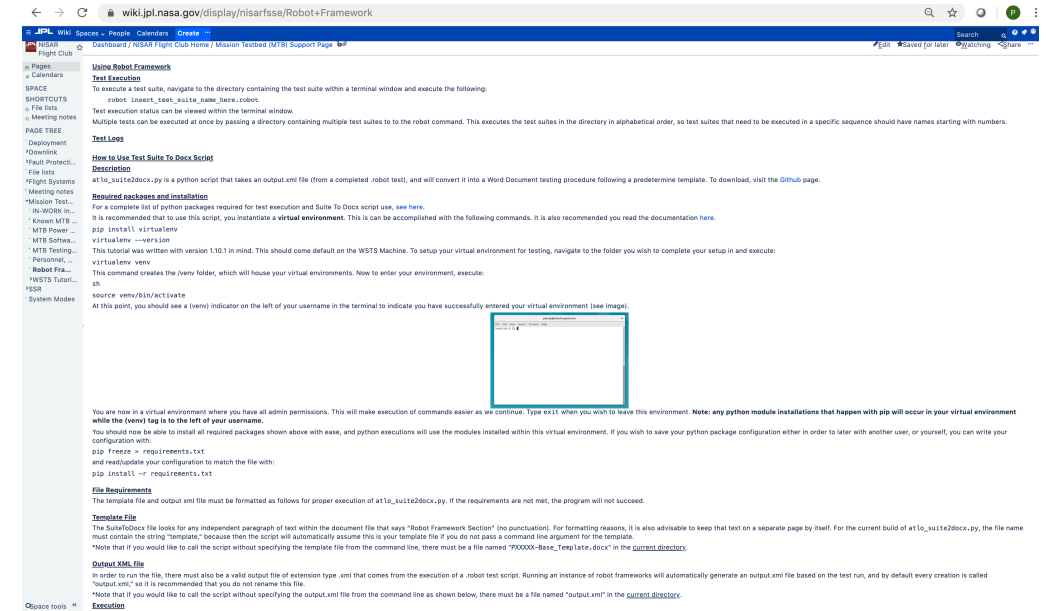
2-4 SSE In the Rack Monitor Window, verify that pc11 and pc21 (for Racks 1 and 2) are GREEN:



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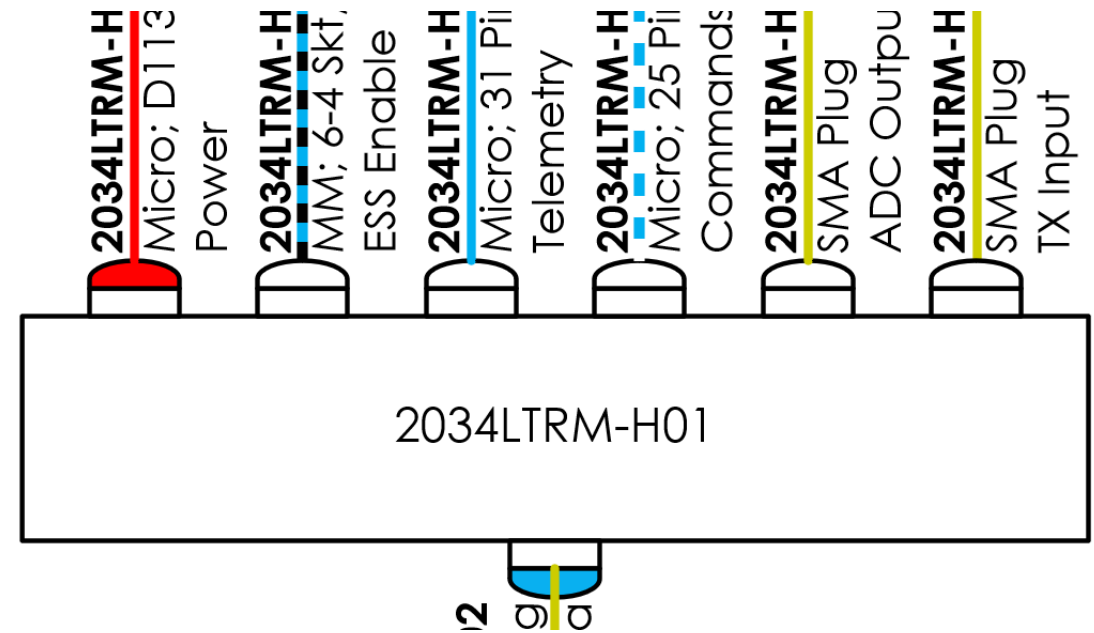
Challenges with Suite-to-docx

- Learning what was “under the hood”
- Operating Systems
- Documentation of code
- Execution on different systems with different Python environments
 - Package Installation
 - Virtual Environments



SIT Scripting - Microsoft Visio

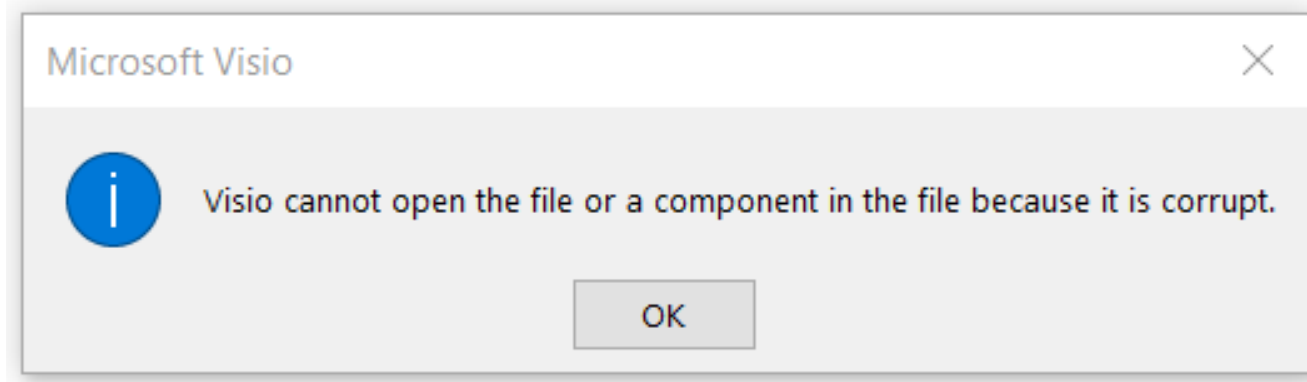
- Procedurally updating Microsoft Visio File to reflect the output of Institutional Mate/Demate Tool
- Tracing the data
- Locating integration of Mate/Demate Data
- Identifying which shape must be updated
- Updating that color



Challenges with Visio Script

- Lack of solid documentation on Microsoft Visio structure
 - Word vs. Visio
- File Corruption during save due to imperfect encoding

- Time



- Next steps determined

Cable Management & Inventory

- Built an inventory for SIT Breakout Box (BOB) Cables
 - Buzzed out & organized new cables
 - Verified continuity, no shorts, and proper isolation.
 - Updated which cables we were missing
 - Allowed team to determine what was still needed
 - Created an online database.



Cable Management & Inventory

- BOB Cable Inventory & checkout system
 - Released the current inventory document to EPDM and placed a physical copy in 306 Hi-bay
 - Wrote a Python application to manage inventory and update changes on the database
 - Will be used to automate BOB Checkout between the various NISAR testbed locations.



NISAR System Integration and Test (SIT) Breakout Box (BOB) Cable Checkout

Initial Release

JPL D-102257

14-August-2019.

Paper copies of this document may not be current and should not be relied on for official purposes. The current version is in TeamCenter (EPDM):
<https://epdm.jpl.nasa.gov:8888/tc/webclient>

Author: Peter Bloch












Raspberry Pi Inventory (“Pinventory”)



Scanner Test ☆

File Edit View Insert Format Data Tools Add-ons Help Last edit was yesterday at 1:05 PM

100% \$ % .0 .00 123 Arial 10 B I A

	A	B	C	D	E	F	G	H
1		Harness	Connector	Version	QR Code	Barcode 128		
2		W2007H001	W2007H001-J01	2.01				
3		W2007H002	W2007H002-J10	1.00				
4		W2007H003	W2007H002-J11	1.00				





Application for BOB Cable Checkout

Pi Checkout GUI

BOB Cable Checkout

8/19/19 3:50 PM

JPL ID

Place cursor in box and scan cable tag:

☐ Inventory Scan

Reset Check In Check Out

Send to Database





- Wiki Spaces People Calendars Create ...

NISAR SIT03_04

 - Pages
 - Blog
 - Calendars
 - SPACE SHORTCUTS
 - Current Mission Plan
 - Useful NISAR Wiki Pages
 - Instrument EGSE Calendar
 - EP and SIT03 Tools
 - EP & SIT03 High Level Flo...
 - NISAR Useful Links
 - MTB Idiosyncrasies and L...
 - I&T Weekly Meetings
 - PAGE TREE

Dashboard
Edit Save for later Watching Share

SIT03/SIT04 Home

Created by Admin API, last modified by Peter J Bloch on Jul 17, 2019

Welcome to the NISAR SIT03/04 Wiki page. This is where you can expect to find any and all information on current work in the department.

```

graph TD
    A["SIT03/SIT04  
Victor Mora, PDM  
David Lopez, Deputy/Lead TC"] --> B["SIT04 I&T System Eng  
• Alok Chatterjee"]
    A --> C["I&T Mech Sys. Eng  
• Emmanuel Hanna"]
    A --> D["Planning/core team"]
    A --> E["Transition from SIT02"]
    A --> F[" "]
    A --> G[" "]
    A --> H[" "]
    A --> I[" "]
    
```

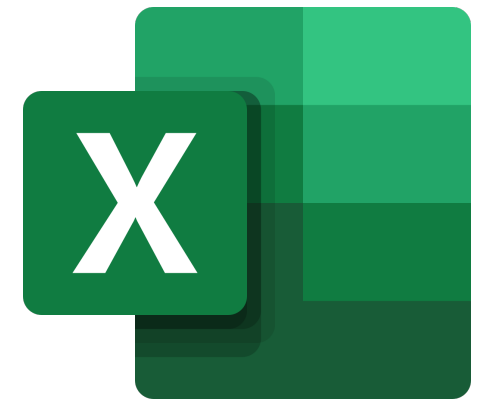
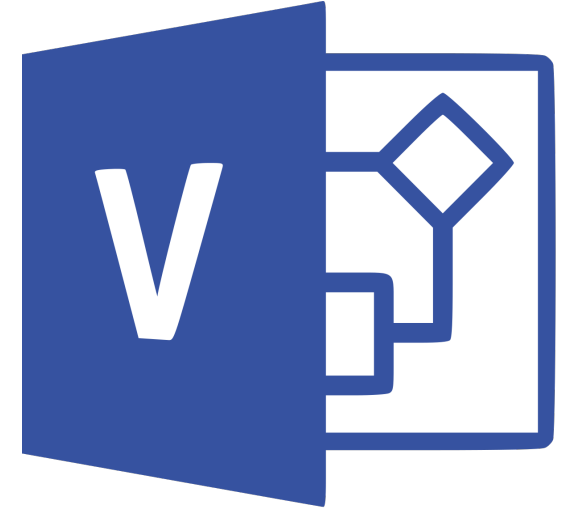
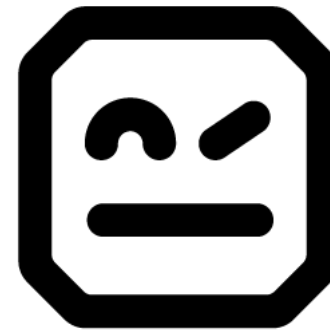


- Time Management
- Effective Communication
- How to ask for help

26	Wednesday
robot framework session key 321-216 Public antonette.w.feldman@j	
NISAR SIT03_04 Weekly Meetings 306 Viewing Gallery Conference room david.a.lopez@jpl.nasa.go	
313 Intern Seminar Series - updates 301-486 marguerite.l.syvert	
FW: Robot Framework on NISAR 179-122 Private robert.castillo@jpl.nas	
Meet with Rich Rich's Office;	

Technical Skills Learned

- Robot Framework
 - Raspbian Application Development
 - Building a GUI in Python
 - Microsoft Visio
-
- Improved my abilities:
 - Python Scripting
 - Excel



Acknowledgements

- Victor Mora, *Mentor and SIT 3/4 Manager*
- David Lopez, *Deputy SIT 3/4 Manager*
- Eisha Tyler, *SIT Electrical Lead*
- Toni Feldman, *EP V&V Lead*
- James Roberts, *EGSE Software Lead*
- Ronald Kinslow, *Group Supervisor 313*
- Robert Castillo, *M2020 POC*
- Nick Zhao, *Fellow Intern*
- Blaire Weinberg, *Fellow Intern*

- Everyone not listed from NISAR SIT & MTB team

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California Institute of Technology

Questions?

