

Integrated Slew

This notebook is used to execute the [LVV-T2215 \(2.0\)](#) test script during System Spread Integration Tests on Level 3.

It is part of the plan [LVV-P81](#) and of the test cycle [LVV-C175](#).

Execution steps are separated by horizontal lines.

Upon completion, save the notebook and its output as a pdf file to be attached to the test execution in JIRA.

History:

- [LVV-T2215 \(1.0\)](#) has a notebook which doesn't do the slew sequence described on the test script. For this reason the version 2.0 was created.
- [LVV-T2215 \(2.0\)](#) is similar to [LVV-T2290 \(2.0\)](#) test case, but without taking a ComCam image.

Execution steps are separated by horizontal lines. Upon completion, save the notebook and its output as a pdf file to be attached to the test execution in JIRA.

Last executed by J. Esteves 20220408

Under Construction:

Things to do:

1. Add log info
2. Test on Tucson

```
In [1]: from lsst.ts import utils

# Extract your name from the Jupyter Hub
__executed_by__ = os.environ["JUPYTERHUB_USER"]

# Extract execution date
__executed_on__ = utils.astrophy_time_from_tai_unix(utils.current_tai())
__executed_on__.format = "isot"

# This is used later to define where Butler stores the images
summit = os.environ["LSST_DDS_PARTITION_PREFIX"] == "summit"

print(f"\nExecuted by {__executed_by__} on {__executed_on__}."
      f"\n  At the summit? {summit}")
```

```
| lsst.ts.utils.tai INFO: Update leap second table
```

```
| lsst.ts.utils.tai INFO: current_tai uses the system TAI clock
```

Executed by blquint on 2022-06-21T03:01:03.983.
At the summit? True

Load all the needed libraries

Using the setup procedure, get the remotes and the components ready.

This includes simulators as well as real hardware when available (this will depend on when the test is conducted at NCSA or on level 3 or on the telescope):

- pointing
 - mount (with the CCW)
 - rotator
 - ready M1M3: raise mirror, turn on FB, clear forces. Note that if used at level 3, we need to have M1M3 LUT use mount telemetry
 - ready M2: turn on FB, clear forces. Note that if used at level 3, we need to have M2 LUT use mount telemetry
 - Get cam hex Ready: check config; make sure LUT is on and has valid inputs; make sure hex is at LUT position
 - Get M2 hex (simulator) Ready: check config; make sure LUT is on and has valid inputs; make sure hex is at LUT position
 - Finally, get the MTAOS CSC ready
-

Run the setup.ipnyb notebook to bring all components up and in their enabled position.
Check Chronograph.

Check Chronograph.

```
In [2]: %load_ext autoreload
        %autoreload 2
```

```
In [3]: import rubin_jupyter_utils.lab.notebook as nb
        nb.utils.get_node()
```

```
/tmp/ipykernel_62751/1665379685.py:2: DeprecationWarning: Call to deprecated f
unction (or staticmethod) get_node. (Please use lsst.rsp.get_node())
      nb.utils.get_node()
```

```
Out[3]: 'yagan07'
```

```
In [16]: import os
         import sys
         import asyncio
         import logging
         import time
```

```

import pandas as pd
import numpy as np

from matplotlib import pyplot as plt
from astropy.time import Time
from datetime import datetime, timedelta
import pandas as pd

from lsst.ts import salobj
from lsst.ts.observatory.control.maintel import MTCS, ComCam
from lsst.ts.observatory.control import RotType

```

```
In [5]: logging.basicConfig(format="%(name)s: %(message)s", level=logging.DEBUG)
```

```
In [6]: log = logging.getLogger("setup")
log.level = logging.DEBUG
```

```
In [7]: domain = salobj.Domain()
```

```
In [8]: mtcs = MTCS(domain=domain, log=log)
mtcs.set_rem_loglevel(40)
```

```

| setup.MTCS DEBUG: mtmount: Adding all resources.
| setup.MTCS DEBUG: mptg: Adding all resources.
| setup.MTCS DEBUG: mtaos: Adding all resources.
| setup.MTCS DEBUG: mtm1m3: Adding all resources.
| setup.MTCS DEBUG: mtm2: Adding all resources.
| setup.MTCS DEBUG: mthexapod_1: Adding all resources.
| setup.MTCS DEBUG: mthexapod_2: Adding all resources.
| setup.MTCS DEBUG: mtrotator: Adding all resources.
| setup.MTCS DEBUG: mtdome: Adding all resources.
| setup.MTCS DEBUG: mtdometrajectory: Adding all resources.
| MTHexapod INFO: Read historical data in 0.04 sec
| MTHexapod INFO: Read historical data in 0.06 sec
| MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 20
|   of 100 elements
| MTHexapod.application WARNING: tel_application DDS read queue is filling: 2
|   0 of 100 elements
| MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 20 of
| 100 elements

```

```
In [9]: await mtcs.start_task
```

```
Out[9]: [None, None, None, None, None, None, None, None, None, None]
```

```

In [12]: async def moveMountInElevationSteps(target_el, azimuth=0, step_size=0.25, time
        """Move the mount from the current elevation angle to the target elevation
        in steps to avoid any issues whe M1M3 and/or M2 are running with the LUT us
        Mount instead of the inclinometer.

        This function will actually calculate the number of steps using the ceiling
        in order to make sure that we move carefully.

        Parameters
        -----

```

```

target_el : float
    Target elevation angle in degrees
azimuth : float
    Azimuth angle in degrees (default)
step_size : float
    Step elevation size in degrees (default: 0.25)
time_sleep : float
    Sleep time between movements (default: 1)

Returns
-----
azimuth : float
    Current azimuth
elevation : float
    Current elevation
"""
current_el = mtcs.rem.mtmount.tel_elevation.get().actualPosition
n_steps = int(np.ceil(np.abs(current_el - target_el) / step_size))

for el in np.linspace(current_el, target_el, n_steps):
    print(f"Moving elevation to {el:.2f} deg")
    await mtcs.rem.mtmount.cmd_moveToTarget.set_start(azimuth=azimuth, elev
    time.sleep(time_sleep)

return azimuth, el

```

Slew Sequence

Exercise the telescope on elevation between 86.5° and 82.5° with 4 slews. **No tracking is needed**

```

target_1 -> az = 180.0$^o$, el = 86.5$^o$
target_2 -> az = 180.0$^o$, el = 85.0$^o$
target_3 -> az = 180.0$^o$, el = 83.5$^o$
target_4 -> az = 180.0$^o$, el = 82.0$^o$

```

```

In [ ]: caution = False

if not caution:
    print("Slew 1: el=86.5")
    await mtcs.point_azel(az=180.0, el=86.5)

    print("Slew 2: el=85.0")
    await mtcs.point_azel(az=180.0, el=85.0)

    print("Slew 3: el=83.5")
    await mtcs.point_azel(az=180.0, el=83.5)

    print("Slew 4: el=82.0")
    await mtcs.point_azel(az=180.0, el=82.0)

# await mtcs.stop_tracking()

```

```
In [10]: # Move only the azimuth for now
await mtcs.point_azel(az=190.0, el=90)
```

```
setup.MTCS DEBUG: Stop tracking.
setup.MTCS DEBUG: Wait 5.0s for rotator to settle down.
setup.MTCS DEBUG: Workaround for rotator trajectory problem. Moving rotator
to its current position: 0.10
setup.MTCS DEBUG: Wait for MTRotator in position event.
setup.MTCS DEBUG: MTRotator in position: True.
setup.MTCS DEBUG: MTRotator already in position. Handling potential race co
ndition.
setup.MTCS INFO: MTRotator in position: False.
setup.MTCS INFO: MTRotator in position: True.
setup.MTCS DEBUG: MTRotator in position True. Waiting settle time 5.0s
setup.MTCS DEBUG: Sending slew command.
setup.MTCS DEBUG: Scheduling check coroutines
setup.MTCS DEBUG: process as completed...
setup.MTCS DEBUG: Monitor position started.
setup.MTCS DEBUG: Waiting for Target event from mtmount.
setup.MTCS DEBUG: mtmount: <State.ENABLED: 2>
setup.MTCS DEBUG: mtptg: <State.ENABLED: 2>
setup.MTCS DEBUG: mtaos: <State.ENABLED: 2>
setup.MTCS DEBUG: mtm1m3: <State.ENABLED: 2>
setup.MTCS DEBUG: mtm2: <State.ENABLED: 2>
setup.MTCS DEBUG: mthexapod_1: <State.ENABLED: 2>
setup.MTCS DEBUG: mthexapod_2: <State.ENABLED: 2>
setup.MTCS DEBUG: mtrotator: <State.ENABLED: 2>
setup.MTCS DEBUG: Wait for mtmount in position events.
setup.MTCS DEBUG: Wait for dome in position event.
setup.MTCS DEBUG: Wait for MTRotator in position event.
setup.MTCS DEBUG: MTRotator in position: True.
setup.MTCS DEBUG: MTRotator already in position. Handling potential race co
ndition.
setup.MTCS DEBUG: Wait for MTMount elevation in position event.
setup.MTCS DEBUG: MTMount elevation in position: True.
setup.MTCS DEBUG: MTMount elevation already in position. Handling potential
race condition.
setup.MTCS DEBUG: Wait for MTMount azimuth in position event.
setup.MTCS DEBUG: MTMount azimuth in position: True.
setup.MTCS DEBUG: MTMount azimuth already in position. Handling potential r
ace condition.
setup.MTCS DEBUG: Mount target: private_revCode: bdc000ba, private_sndStam
p: 1655780562.4957714, private_rcvStamp: 1655780562.495974, private_seqNum:
41454, private_identity: MTMount, private_origin: 44621, elevation: 90.0, e
levationVelocity: 0.0, azimuth: 190.0, azimuthVelocity: 0.0, taiTime: 16557
80562.5550904, trackId: 1, tracksys: LOCAL, radesys: , priority: 0
setup.MTCS INFO: MTMount elevation in position: False.
setup.MTCS INFO: MTMount azimuth in position: False.
setup.MTCS INFO: MTMount elevation in position: True.
setup.MTCS DEBUG: MTMount elevation in position True. Waiting settle time
3.0s
```

```

setup.MTCS DEBUG: [Tel]: Az = +000.004[-170.0]; El = +090.002[ -0.0] [Rot]: +000.100[ +0.0] [Dome] Az = +000.000; El = +000.000
setup.MTCS DEBUG: Dome azimuth in position.
setup.MTCS DEBUG: Dome elevation in position.
setup.MTCS INFO: MTRotator in position: False.
setup.MTCS INFO: MTRotator in position: True.
setup.MTCS DEBUG: MTRotator in position True. Waiting settle time 3.0s
setup.MTCS DEBUG: [Tel]: Az = +033.505[+156.5]; El = +090.000[ +0.0] [Rot]: -000.000[ -0.0] [Dome] Az = +000.000; El = +000.000
setup.MTCS DEBUG: [Tel]: Az = +074.665[+115.3]; El = +090.000[ +0.0] [Rot]: -000.000[ +0.0] [Dome] Az = +000.000; El = +000.000
setup.MTCS DEBUG: [Tel]: Az = +115.817[ +74.2]; El = +090.000[ +0.0] [Rot]: -000.000[ -0.0] [Dome] Az = +000.000; El = +000.000
setup.MTCS DEBUG: [Tel]: Az = +157.258[ +32.7]; El = +090.000[ +0.0] [Rot]: -000.000[ -0.0] [Dome] Az = +000.000; El = +000.000
setup.MTCS INFO: MTMount azimuth in position: True.
setup.MTCS DEBUG: MTMount azimuth in position True. Waiting settle time 3.0s
setup.MTCS DEBUG: [Tel]: Az = +190.000[ +0.0]; El = +090.000[ +0.0] [Rot]: -000.000[ -0.0] [Dome] Az = +000.000; El = +000.000

```

In [17]: **await** moveMountInElevationSteps(90., azimuth=190)

```

Moving elevation to 89.00 deg
Moving elevation to 89.33 deg
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 10 of 100 elements
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 20 of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 10 of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 20 of 100 elements
MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 20 of 100 elements
Moving elevation to 89.67 deg
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 20 of 100 elements
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 10 of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 21 of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 10 of 100 elements
MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 20 of 100 elements
Moving elevation to 90.00 deg
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 20 of 100 elements
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 10 of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 20 of 100 elements

```

```

MTHexapod.application WARNING: tel_application DDS read queue is filling: 1
0 of 100 elements
MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 19 of
100 elements
MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 10 of
100 elements

```

Out[17]: (190, 90.0)

```

MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 20
of 100 elements
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 10
of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 2
0 of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 1
0 of 100 elements
MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 20 of
100 elements

```

```

In [18]: await mtcs.set_state(
          state=salobj.State.ENABLED,
          components=["mtm1m3"],
          overrides = {"mtm1m3": 'Default'}
        )

```

```

MTM1M3.logevent_forceActuatorForceWarning ERROR: evt_forceActuatorForceWarn
ing DDS read queue is full (100 elements); data may be lost
setup.MTCS DEBUG: [mtm1m3]: [<State.FAULT: 3>, <State.STANDBY: 5>, <State.D
ISABLED: 1>, <State.ENABLED: 2>]
setup.MTCS INFO: All components in <State.ENABLED: 2>.

```

```

In [19]: await mtcs.raise_m1m3()

```

```

setup.MTCS DEBUG: M1M3 current detailed state {<DetailedState.PARKEDENGINEE
RING: 9>, <DetailedState.PARKED: 5>}, executing command...
setup.MTCS DEBUG: process as completed...
setup.MTCS DEBUG: M1M3 detailed state 6
setup.MTCS DEBUG: mtm1m3: <State.ENABLED: 2>
setup.MTCS DEBUG: mtm1m3: <State.ENABLED: 2>
setup.MTCS DEBUG: M1M3 detailed state 7

```

```

In [20]: await mtcs.enable_m1m3_balance_system()

```

```

setup.MTCS DEBUG: Enabling hardpoint corrections.

```

```

In [21]: await mtcs.reset_m1m3_forces()

```

```

In [22]: await moveMountInElevationSteps(86., azimuth=190)

```

```

Moving elevation to 90.00 deg
Moving elevation to 89.73 deg

```

```

MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 10
of 100 elements
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 20
of 100 elements

```

```
MTHexapod.application WARNING: tel_application DDS read queue is filling: 1
0 of 100 elements
MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 10 of
100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 2
1 of 100 elements
MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 20 of
100 elements
Moving elevation to 89.47 deg
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 20
of 100 elements
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 10
of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 2
1 of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 1
0 of 100 elements
MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 20 of
100 elements
Moving elevation to 89.20 deg
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 20
of 100 elements
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 10
of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 2
0 of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 1
0 of 100 elements
MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 19 of
100 elements
Moving elevation to 88.93 deg
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 20
of 100 elements
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 10
of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 1
0 of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 2
1 of 100 elements
MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 20 of
100 elements
Moving elevation to 88.67 deg
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 10
of 100 elements
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 20
of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 1
0 of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 2
0 of 100 elements
MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 19 of
100 elements
```



```
MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 10 of
100 elements
Moving elevation to 88.40 deg
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 10
of 100 elements
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 20
of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 1
0 of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 2
0 of 100 elements
MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 11 of
100 elements
MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 20 of
100 elements
Moving elevation to 88.13 deg
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 20
of 100 elements
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 10
of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 1
0 of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 2
1 of 100 elements
MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 20 of
100 elements
Moving elevation to 87.87 deg
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 20
of 100 elements
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 10
of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 2
0 of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 1
0 of 100 elements
MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 20 of
100 elements
Moving elevation to 87.60 deg
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 20
of 100 elements
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 10
of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 2
1 of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 1
0 of 100 elements
MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 20 of
100 elements
Moving elevation to 87.33 deg
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 20
of 100 elements
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 10
of 100 elements
```

```
MTHexapod.application WARNING: tel_application DDS read queue is filling: 1
0 of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 2
1 of 100 elements
MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 20 of
100 elements
Moving elevation to 87.07 deg
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 20
of 100 elements
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 10
of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 2
0 of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 1
0 of 100 elements
MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 19 of
100 elements
Moving elevation to 86.80 deg
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 20
of 100 elements
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 10
of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 2
0 of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 1
0 of 100 elements
MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 19 of
100 elements
Moving elevation to 86.53 deg
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 20
of 100 elements
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 10
of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 2
0 of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 1
0 of 100 elements
MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 19 of
100 elements
Moving elevation to 86.27 deg
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 10
of 100 elements
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 20
of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 1
0 of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 2
0 of 100 elements
MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 19 of
100 elements
MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 10 of
100 elements
Moving elevation to 86.00 deg
```

```

MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 20
of 100 elements
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 10
of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 2
0 of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 1
0 of 100 elements
MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 19 of
100 elements
MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 10 of
100 elements

```

Out[22]: (190, 86.0)

```

MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 20
of 100 elements
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 10
of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 2
0 of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is filling: 1
0 of 100 elements
MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 19 of
100 elements

```

Slew to target 1:

In [23]: `await mtcs.point_azel(az=180.0, el=85.5)`

```

setup.MTCS DEBUG: Stop tracking.
setup.MTCS DEBUG: Wait 5.0s for rotator to settle down.
setup.MTCS DEBUG: Workaround for rotator trajectory problem. Moving rotator
to its current position: -0.10
setup.MTCS DEBUG: Wait for MTRotator in position event.
setup.MTCS DEBUG: MTRotator in position: True.
setup.MTCS DEBUG: MTRotator already in position. Handling potential race co
ndition.
setup.MTCS INFO: MTRotator in position: False.
setup.MTCS INFO: MTRotator in position: True.
setup.MTCS DEBUG: MTRotator in position True. Waiting settle time 5.0s
setup.MTCS DEBUG: Sending slew command.
setup.MTCS DEBUG: Scheduling check coroutines
setup.MTCS DEBUG: process as completed...
setup.MTCS DEBUG: Monitor position started.
setup.MTCS DEBUG: Waiting for Target event from mtmount.
setup.MTCS DEBUG: mtmount: <State.ENABLED: 2>
setup.MTCS DEBUG: mtptg: <State.ENABLED: 2>
setup.MTCS DEBUG: mtaos: <State.ENABLED: 2>
setup.MTCS DEBUG: mtm1m3: <State.ENABLED: 2>
setup.MTCS DEBUG: mtm2: <State.ENABLED: 2>

```

```

| setup.MTCS DEBUG: mthexapod_1: <State.ENABLED: 2>
| setup.MTCS DEBUG: mthexapod_2: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtrotator: <State.ENABLED: 2>
| setup.MTCS DEBUG: Wait for mtmount in position events.
| setup.MTCS DEBUG: Wait for dome in position event.
| setup.MTCS DEBUG: Wait for MTRotator in position event.
| setup.MTCS DEBUG: MTRotator in position: True.
| setup.MTCS DEBUG: MTRotator already in position. Handling potential race co
ndition.
| setup.MTCS DEBUG: Wait for MTMount elevation in position event.
| setup.MTCS DEBUG: MTMount elevation in position: True.
| setup.MTCS DEBUG: MTMount elevation already in position. Handling potential
race condition.
| setup.MTCS DEBUG: Wait for MTMount azimuth in position event.
| setup.MTCS DEBUG: MTMount azimuth in position: True.
| setup.MTCS DEBUG: MTMount azimuth already in position. Handling potential r
ace condition.
| setup.MTCS DEBUG: Mount target: private_revCode: bdc00ba, private_sndStam
p: 1655781231.9421356, private_rcvStamp: 1655781231.942337, private_seqNum:
45689, private_identity: MTMount, private_origin: 44621, elevation: 85.5, e
levationVelocity: 0.0, azimuth: 180.0, azimuthVelocity: 0.0, taiTime: 16557
81232.0012834, trackId: 3, tracksys: LOCAL, radesys: , priority: 0
| setup.MTCS INFO: MTMount elevation in position: False.
| setup.MTCS INFO: MTMount azimuth in position: False.
| setup.MTCS INFO: MTRotator in position: False.
| setup.MTCS INFO: MTRotator in position: True.
| setup.MTCS DEBUG: MTRotator in position True. Waiting settle time 3.0s
| setup.MTCS INFO: MTMount elevation in position: True.
| setup.MTCS DEBUG: MTMount elevation in position True. Waiting settle time
3.0s
| setup.MTCS DEBUG: [Tel]: Az = +189.999[ -10.0]; El = +086.000[ -0.5] [Ro
t]: -000.100[ +0.0] [Dome] Az = +000.000; El = +000.000
| setup.MTCS DEBUG: Dome azimuth in position.
| setup.MTCS DEBUG: Dome elevation in position.
| setup.MTCS INFO: MTMount azimuth in position: True.
| setup.MTCS DEBUG: MTMount azimuth in position True. Waiting settle time 3.0
s

```

Slew to target_2:

```
In [24]: await mtcs.point_azel(az=180.0, el=85.0)
```

```

| setup.MTCS DEBUG: Stop tracking.
| setup.MTCS DEBUG: Wait 5.0s for rotator to settle down.
| setup.MTCS DEBUG: Workaround for rotator trajectory problem. Moving rotator
to its current position: 0.10
| setup.MTCS DEBUG: Wait for MTRotator in position event.
| setup.MTCS DEBUG: MTRotator in position: True.
| setup.MTCS DEBUG: MTRotator already in position. Handling potential race co
ndition.

```

```

| setup.MTCS INFO: MTRotator in position: False.
| setup.MTCS INFO: MTRotator in position: True.
| setup.MTCS DEBUG: MTRotator in position True. Waiting settle time 5.0s
| setup.MTCS DEBUG: Sending slew command.
| setup.MTCS DEBUG: Scheduling check coroutines
| setup.MTCS DEBUG: process as completed...
| setup.MTCS DEBUG: Monitor position started.
| setup.MTCS DEBUG: Waiting for Target event from mtmount.
| setup.MTCS DEBUG: mtmount: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtptg: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtaos: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtm1m3: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtm2: <State.ENABLED: 2>
| setup.MTCS DEBUG: mthexapod_1: <State.ENABLED: 2>
| setup.MTCS DEBUG: mthexapod_2: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtrotator: <State.ENABLED: 2>
| setup.MTCS DEBUG: Wait for mtmount in position events.
| setup.MTCS DEBUG: Wait for dome in position event.
| setup.MTCS DEBUG: Wait for MTRotator in position event.
| setup.MTCS DEBUG: MTRotator in position: True.
| setup.MTCS DEBUG: MTRotator already in position. Handling potential race co
ndition.
| setup.MTCS DEBUG: Wait for MTMount elevation in position event.
| setup.MTCS DEBUG: MTMount elevation in position: True.
| setup.MTCS DEBUG: MTMount elevation already in position. Handling potential
race condition.
| setup.MTCS DEBUG: Wait for MTMount azimuth in position event.
| setup.MTCS DEBUG: MTMount azimuth in position: True.
| setup.MTCS DEBUG: MTMount azimuth already in position. Handling potential r
ace condition.
| setup.MTCS DEBUG: Mount target: private_revCode: bdc00ba, private_sndStam
p: 1655781261.277857, private_rcvStamp: 1655781261.2780354, private_seqNum:
45944, private_identity: MTMount, private_origin: 44621, elevation: 85.0, e
levationVelocity: 0.0, azimuth: 180.0, azimuthVelocity: 0.0, taiTime: 16557
81261.3371243, trackId: 4, tracksys: LOCAL, radesys: , priority: 0
| setup.MTCS INFO: MTMount elevation in position: False.
| setup.MTCS INFO: MTRotator in position: False.
| setup.MTCS INFO: MTRotator in position: True.
| setup.MTCS DEBUG: MTRotator in position True. Waiting settle time 3.0s
| setup.MTCS DEBUG: [Tel]: Az = +180.000[ +0.0]; El = +085.497[ -0.5] [Ro
t]: +000.100[ -0.0] [Dome] Az = +000.000; El = +000.000
| setup.MTCS DEBUG: Dome azimuth in position.
| setup.MTCS DEBUG: Dome elevation in position.
| setup.MTCS INFO: MTMount elevation in position: True.
| setup.MTCS DEBUG: MTMount elevation in position True. Waiting settle time
3.0s
| setup.MTCS DEBUG: No new in position event in the last 3.0s. Assuming MTMou
nt azimuth in position.
| setup.MTCS DEBUG: MTMount azimuth in position True. Waiting settle time 3.0
s

```

Slew to target_3

In [25]: `await mtcs.point_azel(az=180.0, el=84.5)`

```

| setup.MTCS DEBUG: Stop tracking.
| setup.MTCS DEBUG: Wait 5.0s for rotator to settle down.
| setup.MTCS DEBUG: Workaround for rotator trajectory problem. Moving rotator
| to its current position: -0.10
| setup.MTCS DEBUG: Wait for MTRotator in position event.
| setup.MTCS DEBUG: MTRotator in position: True.
| setup.MTCS DEBUG: MTRotator already in position. Handling potential race co
| ndition.
| setup.MTCS INFO: MTRotator in position: False.
| setup.MTCS INFO: MTRotator in position: True.
| setup.MTCS DEBUG: MTRotator in position True. Waiting settle time 5.0s
| setup.MTCS DEBUG: Sending slew command.
| setup.MTCS DEBUG: Scheduling check coroutines
| setup.MTCS DEBUG: process as completed...
| setup.MTCS DEBUG: Monitor position started.
| setup.MTCS DEBUG: Waiting for Target event from mtmount.
| setup.MTCS DEBUG: mtmount: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtptg: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtaos: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtm1m3: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtm2: <State.ENABLED: 2>
| setup.MTCS DEBUG: mthexapod_1: <State.ENABLED: 2>
| setup.MTCS DEBUG: mthexapod_2: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtrotator: <State.ENABLED: 2>
| setup.MTCS DEBUG: Wait for mtmount in position events.
| setup.MTCS DEBUG: Wait for dome in position event.
| setup.MTCS DEBUG: Wait for MTRotator in position event.
| setup.MTCS DEBUG: MTRotator in position: True.
| setup.MTCS DEBUG: MTRotator already in position. Handling potential race co
| ndition.
| setup.MTCS DEBUG: Wait for MTMount elevation in position event.
| setup.MTCS DEBUG: MTMount elevation in position: True.
| setup.MTCS DEBUG: MTMount elevation already in position. Handling potential
| race condition.
| setup.MTCS DEBUG: Wait for MTMount azimuth in position event.
| setup.MTCS DEBUG: MTMount azimuth in position: True.
| setup.MTCS DEBUG: MTMount azimuth already in position. Handling potential r
| ace condition.
| setup.MTCS DEBUG: Mount target: private_revCode: bdc000ba, private_sndStam
| p: 1655781293.117823, private_rcvStamp: 1655781293.1180189, private_seqNum:
| 46249, private_identity: MTMount, private_origin: 44621, elevation: 84.5, e
| levationVelocity: 0.0, azimuth: 180.0, azimuthVelocity: 0.0, taiTime: 16557
| 81293.1765425, trackId: 5, tracksys: LOCAL, radesys: , priority: 0
| setup.MTCS INFO: MTMount elevation in position: False.
| setup.MTCS INFO: MTRotator in position: False.

```



```

| setup.MTCS INFO: MTRotator in position: True.
| setup.MTCS DEBUG: MTRotator in position True. Waiting settle time 3.0s
| setup.MTCS INFO: MTMount elevation in position: True.
| setup.MTCS DEBUG: MTMount elevation in position True. Waiting settle time
| 3.0s
| setup.MTCS DEBUG: [Tel]: Az = +180.000[ +0.0]; El = +084.996[ -0.5] [Ro
| t]: -000.100[ +0.0] [Dome] Az = +000.000; El = +000.000
| setup.MTCS DEBUG: Dome azimuth in position.
| setup.MTCS DEBUG: Dome elevation in position.
| setup.MTCS DEBUG: No new in position event in the last 3.0s. Assuming MTMou
| nt azimuth in position.
| setup.MTCS DEBUG: MTMount azimuth in position True. Waiting settle time 3.0
| s

```

Slew to target 4

In [26]: `await mtcs.point_azel(az=180.0, el=84)`

```

| setup.MTCS DEBUG: Stop tracking.
| setup.MTCS DEBUG: Wait 5.0s for rotator to settle down.
| setup.MTCS DEBUG: Workaround for rotator trajectory problem. Moving rotator
| to its current position: 0.10
| setup.MTCS DEBUG: Wait for MTRotator in position event.
| setup.MTCS DEBUG: MTRotator in position: True.
| setup.MTCS DEBUG: MTRotator already in position. Handling potential race co
| ndition.
| setup.MTCS INFO: MTRotator in position: False.
| setup.MTCS INFO: MTRotator in position: True.
| setup.MTCS DEBUG: MTRotator in position True. Waiting settle time 5.0s
| setup.MTCS DEBUG: Sending slew command.
| setup.MTCS DEBUG: Scheduling check coroutines
| setup.MTCS DEBUG: process as completed...
| setup.MTCS DEBUG: Monitor position started.
| setup.MTCS DEBUG: Waiting for Target event from mtmount.
| setup.MTCS DEBUG: mtmount: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtptg: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtaos: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtm1m3: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtm2: <State.ENABLED: 2>
| setup.MTCS DEBUG: mthexapod_1: <State.ENABLED: 2>
| setup.MTCS DEBUG: mthexapod_2: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtrotator: <State.ENABLED: 2>
| setup.MTCS DEBUG: Wait for mtmount in position events.
| setup.MTCS DEBUG: Wait for dome in position event.
| setup.MTCS DEBUG: Wait for MTRotator in position event.
| setup.MTCS DEBUG: MTRotator in position: True.
| setup.MTCS DEBUG: MTRotator already in position. Handling potential race co
| ndition.
| setup.MTCS DEBUG: Wait for MTMount elevation in position event.

```

```

| setup.MTCS DEBUG: MTMount elevation in position: True.
| setup.MTCS DEBUG: MTMount elevation already in position. Handling potential
| race condition.
| setup.MTCS DEBUG: Wait for MTMount azimuth in position event.
| setup.MTCS DEBUG: MTMount azimuth in position: True.
| setup.MTCS DEBUG: MTMount azimuth already in position. Handling potential r
| ace condition.
| setup.MTCS DEBUG: Mount target: private_revCode: bdc00ba, private_sndStam
| p: 1655781315.6453989, private_rcvStamp: 1655781315.6456833, private_seqNu
| m: 46368, private_identity: MTMount, private_origin: 44621, elevation: 84.
| 0, elevationVelocity: 0.0, azimuth: 180.0, azimuthVelocity: 0.0, taiTime: 1
| 655781315.7045403, trackId: 6, tracksys: LOCAL, radesys: , priority: 0
| setup.MTCS INFO: MTMount elevation in position: False.
| setup.MTCS INFO: MTRotator in position: False.
| setup.MTCS INFO: MTRotator in position: True.
| setup.MTCS DEBUG: MTRotator in position True. Waiting settle time 3.0s
| setup.MTCS DEBUG: [Tel]: Az = +180.000[ +0.0]; El = +084.496[ -0.5] [Ro
| t]: +000.100[ -0.0] [Dome] Az = +000.000; El = +000.000
| setup.MTCS DEBUG: Dome azimuth in position.
| setup.MTCS DEBUG: Dome elevation in position.
| setup.MTCS INFO: MTMount elevation in position: True.
| setup.MTCS DEBUG: MTMount elevation in position True. Waiting settle time
| 3.0s
| setup.MTCS DEBUG: No new in position event in the last 3.0s. Assuming MTMou
| nt azimuth in position.
| setup.MTCS DEBUG: MTMount azimuth in position True. Waiting settle time 3.0
| s

```

Stop tracking to prevent hitting the Rotator soft limit.

```
In [27]: await mtcs.stop_tracking()
```

```
| setup.MTCS DEBUG: Stop tracking.
```

Plot The Results

```
In [29]: from lsst_efd_client import EfdClient
```

```
In [30]: client = EfdClient("summit_efd")
```

```

| MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 13
| of 100 elements
| MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 27
| of 100 elements
| MTHexapod.application WARNING: tel_application DDS read queue is filling: 1
| 4 of 100 elements
| MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 13 of
| 100 elements

```


MTHexapod.application WARNING: tel_application DDS read queue is filling: 28 of 100 elements

MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 27 of 100 elements

```
In [38]: # Fix this plot
end = Time(datetime.now(), scale='utc')
start = end - timedelta(seconds=1000)

dfm = await client.select_time_series('lsst.sal.MTMount.elevation', 'actualPosi
dfm1m3 = await client.select_time_series('lsst.sal.MTM1M3.logevent_appliedEleva
dfm2 = await client.select_time_series('lsst.sal.MTM2.axialForces', 'lutGravity
dfh = await client.select_time_series('lsst.sal.MTHexapod.application', '*', st

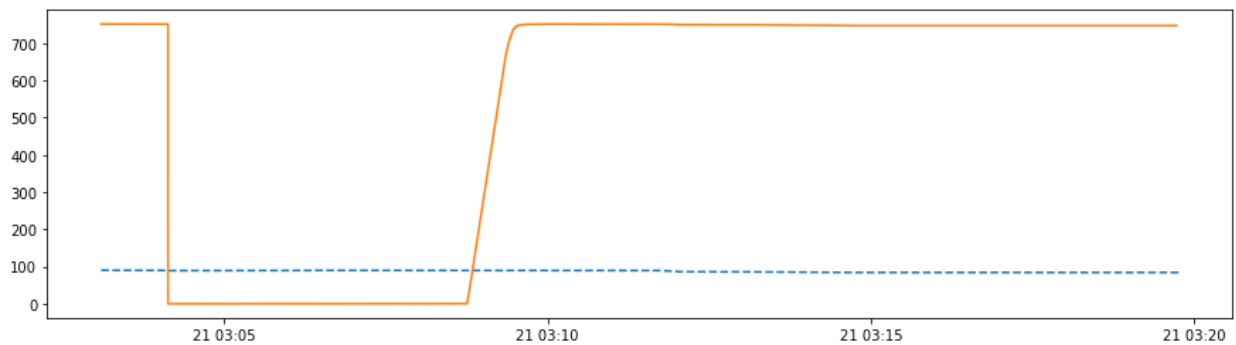
idx1=dfh.MTHexapodID==1
dfh1 = dfh[idx1]
idx2=dfh.MTHexapodID==2
dfh2 = dfh[idx2]

fig, ax = plt.subplots(1,1, figsize=(15,4))
plt.plot(dfm.actualPosition, '--', label='mount elevation')
plt.plot(dfm1m3.zForces0, label='M1M3 elevation y-force 101')
plt.plot(dfm2.lutGravity0, label='M2 elevation force B1')
plt.plot(dfh1.position1, label='Camera hexapod y')
plt.plot(dfh2.position1, label='M2 hexapod y')
plt.grid()
plt.legend()
```

```
-----
AttributeError                                Traceback (most recent call last)
Input In [38], in <cell line: 17>()
    15 plt.plot(dfm.actualPosition, '--', label='mount elevation')
    16 plt.plot(dfm1m3.zForces0, label='M1M3 elevation y-force 101')
---> 17 plt.plot(dfm2.lutGravity0, label='M2 elevation force B1')
    18 plt.plot(dfh1.position1, label='Camera hexapod y')
    19 plt.plot(dfh2.position1, label='M2 hexapod y')

File /opt/lsst/software/stack/conda/miniconda3-py38_4.9.2/envs/lsst-scipipe-3.
0.0/lib/python3.8/site-packages/pandas/core/generic.py:5583, in NDFrame.__geta
ttr__(self, name)
    5576 if (
    5577     name not in self._internal_names_set
    5578     and name not in self._metadata
    5579     and name not in self._accessors
    5580     and self._info_axis._can_hold_identifiers_and_holds_name(name)
    5581 ):
    5582     return self[name]
-> 5583 return object.__getattribute__(self, name)

AttributeError: 'DataFrame' object has no attribute 'lutGravity0'
```



MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 11 of 100 elements

MTHexapod.application WARNING: tel_application DDS read queue is filling: 1 of 100 elements

In [34]: dfm2

Out[34]: —

Wrap Up and Shut Down

This cell is not currently included as part of the test execution, but included here as needed to shutdown the systems

In []: `await mtcs.set_state(salobj.State.STANDBY, components=["mtaos"])`

In []: `await mtcs.lower_mlm3()`

In []: `await mtcs.set_state(salobj.State.STANDBY, components=["mtm1m3"])`

In []: `await mtcs.set_state(salobj.State.STANDBY, components=["mtm2"])`

In []: `await mtcs.set_state(salobj.State.STANDBY, components=["mthexapod_1"])`

In []: `await mtcs.set_state(salobj.State.STANDBY, components=["mthexapod_2"])`

In []: `await mtcs.standby()`

In []: