Slew, Track and Image taking with ComCam This notebook is used for the level 3 integration tests from test plan LVV-P81 (https://jira.lsstcorp.org/secure/Tests.jspa#/testPlan/LVV-P81) as part of test cylce LVV-C176 (https://jira.lsstcorp.org/secure/Tests.jspa#/testCycle/LVV-C176). The following tests are currently run as part of this notebook: LVV-T2290 (https://jira.lsstcorp.org/secure/Tests.jspa#/testCase/LVV-T2290) 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 on 20220128 Run the setup ipnyb notebook to bring all components up and in their enabled position. Check Chronograph. Bring ComCom online and tranistion it to EnabledState. Check Chronograph. In [1]: %load\_ext autoreload %autoreload 2 In [2]: import rubin jupyter utils.lab.notebook as nb nb.utils.get\_node() /tmp/ipykernel 62427/1665379685.py:2: DeprecationWarning: Call to deprecated function (or staticmethod) get node. (Please use lsst.rsp.get node()) nb.utils.get\_node() 'yagan03' Out[2]: In [3]: import os import sys import asyncio import logging import pandas as pd import numpy as np from matplotlib import pyplot as plt from lsst.ts import salobj from lsst.ts.observatory.control.maintel import MTCS, ComCam from lsst.ts.observatory.control import RotType lsst.ts.utils.tai INFO: Update leap second table lsst.ts.utils.tai INFO: current\_tai uses the system TAI clock logging.basicConfig(format="%(name)s:%(message)s", level=logging.DEBUG) In [5]: log = logging.getLogger("setup") log.level = logging.DEBUG In [6]: domain = salobj.Domain() In [7]: mtcs = MTCS(domain=domain, log=log) mtcs.set\_rem\_loglevel(40) setup.MTCS DEBUG: mtmount: Adding all resources. setup.MTCS DEBUG: mtptg: 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. In [8]: await mtcs.start task MTHexapod INFO: Read historical data in 0.05 sec MTHexapod INFO: Read historical data in 0.06 sec MTHexapod.electrical WARNING: electrical DDS read queue is filling: 10 of 100 elements MTHexapod.electrical WARNING: electrical DDS read queue is filling: 21 of 100 elements [None, None, None, None, None, None, None, None, None] Out[8]: MTHexapod.application WARNING: application DDS read queue is filling: 10 of 100 elements MTHexapod.application WARNING: application DDS read queue is filling: 21 of 100 elements MTHexapod.actuators WARNING: actuators DDS read queue is filling: 10 of 100 elements In [9]: comcam = ComCam(domain=domain, log=log) MTHexapod.actuators WARNING: actuators DDS read queue is filling: 22 of 100 elements setup.ComCam DEBUG: cccamera: Adding all resources. setup.ComCam DEBUG: ccheaderservice: Adding all resources. setup.ComCam DEBUG: ccarchiver: Adding all resources. In [10]: comcam.set\_rem\_loglevel(40) In [11]: await comcam.start task [None, None, None] Out[11]: In [24]: await comcam.enable() setup.ComCam DEBUG: [cccamera]::[<State.ENABLED: 2>, <State.DISABLED: 1>, <State.STANDBY: 5>] setup.ComCam DEBUG: [ccheaderservice]::[<State.ENABLED: 2>, <State.DISABLED: 1>, <State.STANDBY: 5>] setup.ComCam DEBUG: [ccarchiver]::[<State.ENABLED: 2>, <State.DISABLED: 1>, <State.STANDBY: 5>] setup.ComCam INFO: All components in <State.STANDBY: 5>. Find four targets separated by  $5^{\circ}$  in azimuth and elevation in a square pattern around az =  $120^{\circ}$  and el =  $60^{\circ}$  and rotator angle at PhysicalSky and  $1.8^{\circ}$ . At this position, the rotator stays within a couple of degrees of its initial position. This is because the CCW is not running (MTmount in simulation mode). target\_1 -> az =  $117.5^{\circ}$ , el =  $57.5^{\circ}$  $target_2 -> az = 122.5^o$ , el =57.5 $^o$  $target_3 \rightarrow az = 122.5^o, el=62.5^o$  $target_4 -> az = 117.5^o$ ,  $el = 62.5^o$ In [13]: target 1 = await mtcs.find target(az=117.5, el=57.5, mag limit=9) target 2 = await mtcs.find target(az=122.5, el=57.5, mag limit=9) target 3 = await mtcs.find target(az=122.5, el=62.5, mag limit=9) target 4 = await mtcs.find target(az=117.5, el=62.5, mag limit=9) print(f"Target 1: {target 1}" f"Target 2: {target 2}" f"Target 3: {target 3}" f"Target 4: {target 4}") Target 1: HD 193504Target 2: HD 193175Target 3: HD 188300Target 4: HD 188788 Slew to target 1: In [ ]: print(f"Target 1: {target 1}" f"Target 2: {target 2}" f"Target 3: {target 3}" f"Target 4: {target 4}") In [14]: await mtcs.slew object(target 1, rot type=RotType.PhysicalSky, rot=1.9) setup.MTCS INFO: Slewing to HD 193504: 20 22 01.7933 -40 08 40.539 setup.MTCS DEBUG: Setting rotator physical position to 1.9 deg. Rotator will track sky. setup.MTCS WARNING: Camera cable wrap following disabled in MTMount. 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: -0.00 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 condition. setup.MTCS DEBUG: No new in position event in the last 5.0s. Assuming MTRotator in position. 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: mtdome: <State.ENABLED: 2> setup.MTCS DEBUG: mtdometrajectory: <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 rotator in position event. 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 race condition. setup.MTCS INFO: Got False setup.MTCS DEBUG: Rotator not in position setup.MTCS DEBUG: Mount target: private\_revCode: bdcb00ba, private\_sndStamp: 1643378645.7934158, private\_rcvStamp: 1643378645.7938876, private\_seqNum: 3, private\_seq \_identity: MTMount, private\_origin: 52777, elevation: 57.755020246925845, elevationVelocity: 0.0031801077094007527, azimuth: 118.19643387766784, azimuthVelocity: 0.0005981914549432298, taiTime: 1643378645.850471, trackId: 1, tracksys: SIDEREAL, radesys: ICRS, priority: 0 setup.MTCS INFO: MTMount azimuth in position: False. setup.MTCS INFO: MTMount elevation in position: False. setup.MTCS DEBUG: [Tel]: Az = +000.002[+118.2]; El = +089.999[ -32.2] [Rot]: -000.002[ +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: Got True setup.MTCS INFO: Rotator in position. setup.MTCS DEBUG: [Tel]: Az = +046.010[ +72.2]; El = +067.033[ −9.3] [Rot]: +001.761[ −0.0] [Dome] Az = +000.000; El = +000.000 setup.MTCS INFO: MTMount elevation in position: True. setup.MTCS DEBUG: [Tel]: Az = +091.278[ +26.9]; El = +057.795[ -0.0] [Rot]: +001.742[ -0.0] [Dome] Az = +000.000; El = +000.000 setup.MTCS INFO: MTMount azimuth in position: True. Once on target\_1 and tracking, take an image with ComCam In [15]: exp1 = await comcam.take object(15) print(f"Target 1 exposure: {exp1}") setup.ComCam DEBUG: Generating group\_id setup.ComCam DEBUG: imagetype: OBJECT, TCS synchronization not configured. setup.ComCam DEBUG: OBJECT 0001 - 0001 Target 1 exposure: [2022012800001] Slew to target\_2: In [16]: await mtcs.slew object(target 2, rot type=RotType.PhysicalSky, rot=1.9) setup.MTCS INFO: Slewing to HD 193175: 20 20 29.2315 -42 18 24.270 setup.MTCS DEBUG: Setting rotator physical position to 1.9 deg. Rotator will track sky. setup.MTCS WARNING: Camera cable wrap following disabled in MTMount. setup.MTCS DEBUG: Stop tracking. setup.MTCS DEBUG: Wait 5.0s for rotator to settle down. CCHeaderService.logevent\_logMessage ERROR: logMessage DDS read queue is full (100 elements); data may be lost setup.MTCS DEBUG: Workaround for rotator trajectory problem. Moving rotator to its current position: 1.66 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 condition. setup.MTCS INFO: MTRotator in position: False. setup.MTCS INFO: MTRotator in position: True. 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: mtdome: <State.ENABLED: 2> setup.MTCS DEBUG: mtdometrajectory: <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 rotator in position event. setup.MTCS DEBUG: Wait for MTMount elevation in position event. setup.MTCS DEBUG: MTMount elevation in position: False. setup.MTCS DEBUG: Wait for MTMount azimuth in position event. setup.MTCS DEBUG: MTMount azimuth in position: False. setup.MTCS INFO: Got False setup.MTCS DEBUG: Rotator not in position setup.MTCS DEBUG: Mount target: private\_revCode: bdcb00ba, private\_sndStamp: 1643378694.1541986, private\_rcvStamp: 1643378694.154811, private\_seqNum: 757, p e\_identity: MTMount, private\_origin: 52777, elevation: 57.899838880743545, elevationVelocity: 0.003048904972499346, azimuth: 122.33118614756566, azimuthVelocity: |0.0009718439031656737, taiTime: 1643378694.211301, trackId: 2, tracksys: SIDEREAL, radesys: ICRS, priority: 0 setup.MTCS INFO: MTMount elevation in position: True. setup.MTCS DEBUG: [Tel]: Az = +118.221[ +4.1]; El = +057.875[ +0.0] [Rot]: +001.661[ +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 INFO: Got True setup.MTCS INFO: Rotator in position. Once on target\_2 and tracking, take an image with ComCam In [17]: exp2 = await comcam.take object(15) print(f"Target 1 exposure: {exp2}") setup.ComCam DEBUG: Generating group\_id setup.ComCam DEBUG: imagetype: OBJECT, TCS synchronization not configured. setup.ComCam DEBUG: OBJECT 0001 - 0001 Target 1 exposure: [2022012800002] Slew to target\_3 In [18]: await mtcs.slew object(target 3, rot type=RotType.PhysicalSky, rot=1.9) setup.MTCS INFO: Slewing to HD 188300: 19 56 13.0514 -41 41 30.647 setup.MTCS DEBUG: Setting rotator physical position to 1.9 deg. Rotator will track sky. setup.MTCS WARNING: Camera cable wrap following disabled in MTMount. 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: 1.70 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 condition. setup.MTCS DEBUG: No new in position event in the last 5.0s. Assuming MTRotator in position. 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: mtdome: <State.ENABLED: 2> setup.MTCS DEBUG: mtdometrajectory: <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 rotator in position event. setup.MTCS DEBUG: Wait for MTMount elevation in position event. setup.MTCS DEBUG: MTMount elevation in position: False. setup.MTCS DEBUG: Wait for MTMount azimuth in position event. setup.MTCS DEBUG: MTMount azimuth in position: False. setup.MTCS INFO: Got False setup.MTCS DEBUG: Rotator not in position setup.MTCS DEBUG: Mount target: private\_revCode: bdcb00ba, private\_sndStamp: 1643378732.0517182, private\_rcvStamp: 1643378732.0520403, private\_seqNum: 1206, priv ate\_identity: MTMount, private\_origin: 52777, elevation: 62.550011856122, elevationVelocity: 0.003023424805417971, azimuth: 123.08228223774192, azimuthVelocity: 0.0016872385129992125, taiTime: 1643378732.1084495, trackId: 3, tracksys: SIDEREAL, radesys: ICRS, priority: 0 setup.MTCS INFO: MTMount azimuth in position: True. setup.MTCS DEBUG: [Tel]: Az = +122.369[ +0.7]; El = +057.976[ +4.6] [Rot]: +001.697[ -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: Got True setup.MTCS INFO: Rotator in position. setup.MTCS INFO: MTMount elevation in position: True. Once on target\_3 and tracking, take an image with ComCam In [19]: exp3 = await comcam.take object(15) print(f"Target 1 exposure: {exp3}") setup.ComCam DEBUG: Generating group\_id setup.ComCam DEBUG: imagetype: OBJECT, TCS synchronization not configured. setup.ComCam DEBUG: OBJECT 0001 - 0001 Target 1 exposure: [2022012800003] Slew to target 4 In [20]: await mtcs.slew object(target 4, rot type=RotType.PhysicalSky, rot=1.9) setup.MTCS INFO: Slewing to HD 188788: 19 58 23.9310 -38 54 00.529 setup.MTCS DEBUG: Setting rotator physical position to 1.9 deg. Rotator will track sky. setup.MTCS WARNING: Camera cable wrap following disabled in MTMount. 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: 1.67 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 condition. setup.MTCS DEBUG: No new in position event in the last 5.0s. Assuming MTRotator in position. 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: mtdome: <State.ENABLED: 2> setup.MTCS DEBUG: mtdometrajectory: <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 rotator in position event. setup.MTCS DEBUG: Wait for MTMount elevation in position event. setup.MTCS DEBUG: MTMount elevation in position: False. setup.MTCS DEBUG: Wait for MTMount azimuth in position event. setup.MTCS DEBUG: MTMount azimuth in position: False. setup.MTCS INFO: Got False setup.MTCS DEBUG: Rotator not in position setup.MTCS DEBUG: Mount target: private\_revCode: bdcb00ba, private\_sndStamp: 1643378770.3997285, private\_rcvStamp: 1643378770.3999078, private\_seqNum: 1665, priv ate\_identity: MTMount, private\_origin: 52777, elevation: 62.83054255699249, elevationVelocity: 0.0032153021637529398, azimuth: 116.99308773660263, azimuthVelocit y: 0.0010865410816133186, taiTime: 1643378770.4567423, trackId: 4, tracksys: SIDEREAL, radesys: ICRS, priority: 0 setup.MTCS INFO: MTMount elevation in position: True. setup.MTCS DEBUG: [Tel]: Az = +123.102[ −6.1]; El = +062.629[ +0.2] [Rot]: +001.672[ −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: Got True setup.MTCS INFO: Rotator in position. setup.MTCS INFO: MTMount azimuth in position: True. Once on target\_4 and tracking, take an image with ComCam In [21]: exp4 = await comcam.take object(15) print(f"Target 1 exposure: {exp4}") setup.ComCam DEBUG: Generating group\_id setup.ComCam DEBUG: imagetype: OBJECT, TCS synchronization not configured. setup.ComCam DEBUG: OBJECT 0001 - 0001 Target 1 exposure: [2022012800004] Stop tracking to prevent hitting the Rotator soft limit. In [22]: await mtcs.stop\_tracking() setup.MTCS DEBUG: Stop tracking. Use ComCam recent images CCS to ensure that the images were taken (http://ccs.lsst.org/RecentImages/comcam.html). Query the butler to verify that the images are there and check the metadata. This step must be verified using a separate noteboook. 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"]) await mtcs.lower m1m3() 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"]) await mtcs.standby() await comcam.standby()