LARGE SYNOPTIC SURVEY TELESCOPE

Large Synoptic Survey Telescope (LSST)
Data Management

LVV-P65 Fall 2019 Pipelines Release Acceptance Test Campaign Test Plan and Report

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DMTR-201

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Abstract

This is the test plan and report for LVV-P65 (Fall 2019 Pipelines Release Acceptance Test Campaign), an LSST level 2 milestone pertaining to the Data Management Subsystem.

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LVV-P65 Fall 2019 Pipelines Release Acceptance Test Campaign Test Plan and Report

1 Introduction

1.1 Objectives

This Acceptance Test campaign aims to verify a small number of DMSR (LSE-61) requirements related to the LSST Science Pipelines. It will be executed in conjunction with the release of Science Pipelines Version 19.0.0, but the pipeline release is not contingent upon this test campaign. This Test Plan aims to demonstrate that the included requirements have been met by Version 19.0.0 of the Pipelines, and to thus fully verify their completion and readiness for LSST Operations.

1.2 System Overview

The tests to be executed are intended to verify that the DM system satisfies a subset of the requirements outlined in the Data Management System Requirements (DMSR; LSE-61). This subset of requirements is related to pipeline algorithms, and was selected for this campaign to coincide with the release of a new version of the LSST Science Pipelines. Additional DMSR requirements will be verified in later Acceptance Test Campaigns.

Applicable Documents:

LSE-61 Data Management System Requirements
LDM-503 Data Management Test Plan

The tests will be performed using the HSC-RC2 dataset (as defined in DM-11345). When possible, we will start our tests with the data products resulting from processing HSC-RC2 with the w_2019_46 weekly pipelines release (DM-22223) that was used to create v19 of the Science Pipelines.

1.3 Document Overview

This document was generated from Jira, obtaining the relevant information from the LVV-P65 Jira Test Plan and related Test Cycles (LVV-C115).

Section 1 provides an overview of the test campaign, the system under test (Acceptance), the applicable documentation, and explains how this document is organized. Section 2 describes the configuration used for this test. Section 3 describes the necessary roles and lists the individuals assigned to them. including all relevant information that fully describes the test campaign.

Section 4 provides a summary of the test results, including an overview in Table 2, an overall assessment statement and suggestions for possible improvements. Section 5 provides detailed results for each step in each test case.

The current status of test plan LVV-P65 in Jira is **Approved** .

1.4 References

[1] **[LSE-61]**, Dubois-Felsmann, G., Jenness, T., 2018, *LSST Data Management Subsystem Requirements*, LSE-61, URL `https://ls.st/LSE-61`

[2] **[LDM-503]**, O'Mullane, W., Swinbank, J., Jurić, M., Economou, F., 2018, *Data Management Test Plan*, LDM-503, URL `https://ls.st/LDM-503`

2 Test Configuration

2.1 Data Collection

Observing is not required for this test campaign.

2.2 Verification Environment

The “lsst-lsp-stable” instance of the LSST Science Platform (LSP), hosted at the LDF, and the “lsst-dev” development cluster at NCSA. In particular, we will use Release 19.0.0 of the Pipelines, whose release is DM Milestone LDM-503-11b (Test Plan located here).

2.3 Entry Criteria

Release and availability of Science Pipelines version 19.

3 Personnel

The personnel involved in the test campaign are shown in the following table.

Test Plan (LVV-P65) owner:	**Jeffrey Carlin**		
LVV-C115 owner:	**Jeffrey Carlin**		
Test Case	**Assigned to**	**Executed by**	**Additional Test Personnel**
LVV-T41	Jim Bosch		
LVV-T62	Jim Bosch		
LVV-T132	Jeffrey Carlin		
LVV-T40	Jim Bosch		
LVV-T1240	Jim Bosch		
LVV-T378	Leanne Guy		
LVV-T377	Leanne Guy		
LVV-T376	Leanne Guy		
LVV-T28	Colin Slater		
LVV-T43	Jim Bosch		

4 Test Campaign Overview

4.1 Summary

Test Plan **LVV-P65: Fall 2019 Pipelines Release Acceptance Test Campaign**			Approved
Test Cycle **LVV-C115: Fall 2019 Pipelines Release Acceptance Test Campaign**			Not Executed
test case	**status**	**comment**	**issues**
LVV-T41	Not Executed		
LVV-T62	Not Executed		
LVV-T132	Not Executed		
LVV-T40	Not Executed		
LVV-T1240	Not Executed		
LVV-T378	Not Executed		
LVV-T377	Not Executed		
LVV-T376	Not Executed		
LVV-T28	Not Executed		
LVV-T43	Not Executed		

Table 2: Test Campaign Summary

4.2 Overall Assessment

Not yet available.

4.3 Recommended Improvements

Not yet available.

5 Detailed Test Results

5.1 Test Cycle LVV-C115

Open test cycle *Fall 2019 Pipelines Release Acceptance Test Campaign* in Jira.

Fall 2019 Pipelines Release Acceptance Test Campaign
Status: Not Executed

This test cycle verifies a subset of DMSR (LSE-61) requirements related to the LSST Science Pipelines, in order to verify their completion and readiness for LSST Operations (i.e., that the requirements laid out in LSE-61 have been met by the DM Systems).

5.1.1 Software Version/Baseline

All tests will be performed with LSST Science Pipelines release version 19.0.0, including its algorithms and resulting science data products.

5.1.2 Configuration

Not provided.

5.1.3 Test Cases in LVV-C115 Test Cycle

5.1.3.1 Test Case LVV-T41 - Verify implementation of Generate PSF for Visit Images

Open *LVV-T41* test case in Jira.

Verify that Processed Visit Images produced by the DRP and AP pipelines are associated with a model from which one can obtain an image of the PSF given a point on the image.

Preconditions:

Execution status: **Not Executed**

Final comment:

Detailed steps results:

Step	Step Details
1	Description Identify a dataset with processed visit images in multiple filters. Expected Result Actual Result Status: **Not Executed**

2	Description
	Identify the path to the data repository, which we will refer to as 'DATA/path', then execute the following:
	Example Code
	`import lsst.daf.persistence as dafPersist`
	`butler = dafPersist.Butler(inputs='DATA/path')`
	Expected Result
	Butler repo available for reading.
	Actual Result
	Status: **Not Executed**

3	Description Select Objects classified as point sources on at least 10 different processed visit images (including all bands). Evaluate the PSF model at the positions of these Objects, and verify that subtracting a scaled version of the PSF model from the processed visit image yields residuals consistent with pure noise. Expected Result Images with the PSF model subtracted, leaving only residuals that are consistent with being noise. Actual Result Status: **Not Executed**

5.1.3.2 Test Case LVV-T62 - Verify implementation of Provide PSF for Coadded Images

Open *LVV-T62* test case in Jira.

Verify that all coadd images produced by the DRP pipelines include a model from which an image of the PSF at any point on the coadd can be obtained.

Preconditions:
Fully covered by preconditions for LVV-T16.

Execution status: **Not Executed**

Final comment:

Detailed steps results:

Step	Step Details
1	Description Identify a dataset with coadded images in multiple filters. Expected Result Multi-band data that has been processed through the coaddition stage. Actual Result Status: **Not Executed**

2	Description
	Identify the path to the data repository, which we will refer to as 'DATA/path', then execute the following:
	Example Code
	`import lsst.daf.persistence as dafPersist`
	`butler = dafPersist.Butler(inputs='DATA/path')`
	Expected Result
	Butler repo available for reading.
	Actual Result

	Status: **Not Executed**
3	Description Load the exposures, then select Objects classified as point sources on at least 10 different coadd images (including all bands). Evaluate the PSF model at the positions of these Objects, and verify that subtracting a scaled version of the PSF model from the processed visit image yields residuals consistent with pure noise. Expected Result Images with the PSF model subtracted, leaving only residuals that are consistent with being noise. Actual Result Status: **Not Executed**

5.1.3.3 Test Case LVV-T132 - Verify implementation of Pre-cursor and Real Data

Open *LVV-T132* test case in Jira.

Demonstrate that pixel-oriented data from astronomical imaging cameras (precursor or otherwise) can be processed using LSST Science Algorithms and organized for access through the Data Butler Access Client.

Preconditions:

Execution status: **Not Executed**

Final comment:

Detailed steps results:

Step	Step Details
1	Description Confirm that the CI jobs used to test DRP and AP processing successfully run. These jobs use precursor datasets from cameras other than LSST. Expected Result

	Actual Result
	Status: **Not Executed**
2	Description For each of these two datasets, instantiate the Butler, load the data products, and confirm that they exist as expected.
	Expected Result Processed images, catalogs, calibration information, and other related data products are present and accessible via the Butler.
	Actual Result
	Status: **Not Executed**

5.1.3.4 Test Case LVV-T40 - Verify implementation of Generate WCS for Visit Images

Open *LVV-T40* test case in Jira.

Verify that Processed Visit Images produced by the AP and DRP pipelines include FITS WCS accurate to specified **astrometricAccuracy** over the bounds of the image.

Preconditions:

Execution status: **Not Executed**

Final comment:

Detailed steps results:

Step	Step Details
1	Description Identify an appropriate processed dataset for this test.

Expected Result

A dataset with Processed Visit Images available.

Actual Result

Status: **Not Executed**

2 Description

Identify the path to the data repository, which we will refer to as 'DATA/path', then execute the following:

Example Code

```
import lsst.daf.persistence as dafPersist
butler = dafPersist.Butler(inputs='DATA/path')
```

Expected Result

Butler repo available for reading.

Actual Result

Status: **Not Executed**

3 Description

Select a single visit from the dataset, and extract its WCS object and the source list.

Expected Result

A table containing detected sources, and a WCS object associated with that catalog.

Actual Result

Status: **Not Executed**

4 Description

Confirm that each CCD within the visit image contains at least **astrometricMinStandards** astrometric standards that were used in deriving the astrometric solution.

Expected Result

At least **astrometricMinStandards** from each CCD were used in determining the WCS solution.

Actual Result

Status: **Not Executed**

5 Description

Starting from the XY pixel coordinates of the sources, apply the WCS to obtain RA, Dec coordinates.

Expected Result

A list of RA, Dec coordinates for all sources in the catalog.

Actual Result

Status: **Not Executed**

6	Description We will assume that Gaia provides a source of "truth." Match the source list to Gaia DR2, and calculate the positional offset between the test data and the Gaia catalog. Expected Result A matched catalog of sources in common between the test source list and Gaia DR2. Actual Result Status: **Not Executed**
7	Description Apply appropriate cuts to extract the optimal dataset for comparison, then calculate statistics (median, 1-sigma range, etc.; also plot a histogram) of the offsets in milliarcseconds. Confirm that the offset is less than **astrometricAccuracy**. Expected Result Histogram and relevant statistics needed to confirm that the WCS transformation is accurate. Actual Result Status: **Not Executed**
8	Description Repeat Step 5, but for subregions of the image, to confirm that the accuracy criterion is met at all positions. Expected Result **astrometricAccuracy** requirement is met over the entire image. Actual Result Status: **Not Executed**

5.1.3.5 Test Case LVV-T1240 - Verify implementation of minimum astrometric standards per CCD

Open *LVV-T1240* test case in Jira.

Verify that each CCD in a processed dataset had its astrometric solution determined by at least **astrometricMinStandards = 5** astrometric standards.

Preconditions:

Execution status: **Not Executed**

Final comment:

Detailed steps results:

Step	Step Details
1	Description Identify an appropriate processed dataset for this test. Expected Result A dataset with Processed Visit Images. Actual Result Status: **Not Executed**

2	Description
	Identify the path to the data repository, which we will refer to as 'DATA/path', then execute the following:
	Example Code
	`import lsst.daf.persistence as dafPersist`
	`butler = dafPersist.Butler(inputs='DATA/path')`
	Expected Result
	Butler repo available for reading.
	Actual Result

	Status: **Not Executed**
3	Description Select a single visit from the dataset, and extract its calibration data. For a subset of CCDs, check how many astrometric standards contributed to the solution. Confirm that this number is at least **astrometricMinStandards = 5.**
	Expected Result At least **astrometricMinStandards** from each CCD were used in determining the WCS solution.
	Actual Result
	Status: **Not Executed**

5.1.3.6 Test Case LVV-T378 - Verify Calculation of Astrometric Performance Metrics

Open *LVV-T378* test case in Jira.

Verify that the DMS system provides software to calculate astrometric performance metrics, and that the algorithms are properly calculating the desired quantities. Note that because the DMS requirement is that the software shall be provided (and not on the actual measured values of the metrics), we verify all of the requirements via a single test case.

Preconditions:

Execution status: **Not Executed**

Final comment:

Detailed steps results:

Step	Step Details
1	Description Identify the path to the data repository, which we will refer to as 'DATA/path', then execute the following:

Example Code

```
import lsst.daf.persistence as dafPersist
butler = dafPersist.Butler(inputs='DATA/path')
```

Expected Result

Butler repo available for reading.

Actual Result

Status: **Not Executed**

2 Description

Point the butler to an appropriate (precursor or simulated) dataset containing data in all filters, that is sufficient for the purposes of measuring astrometric performance metrics.

Expected Result

Actual Result

Status: **Not Executed**

3 Description

Execute the LSST Stack package 'validate_drp' (or an alternate package that is relevant) on this dataset to perform the measurements of the metrics.

Expected Result

Measurements of validation metrics and the presence of QA plots resulting from the validation pipeline.

Actual Result

Status: **Not Executed**

4 Description

Compare measured astrometry to known (for simulated data) or measured (if using precursor data) values from input (precursor or simulated) data, and confirm that the output values for all of the astrometric performance metrics are as expected.

Expected Result

Measured astrometry metrics that are within reasonable values given the (known) input dataset.

Actual Result

Status: **Not Executed**

5.1.3.7 Test Case LVV-T377 - Verify Calculation of Photometric Performance Metrics

Open *LVV-T377* test case in Jira.

Verify that the DMS system provides software to calculate photometric performance metrics, and that the algorithms are properly calculating the desired quantities. Note that because the DMS requirement is that the software shall be provided (and not on the actual measured values of the metrics), we verify all of the requirements via a single test case.

Preconditions:

Execution status: **Not Executed**

Final comment:

Detailed steps results:

Step	Step Details

1	Description
	Identify the path to the data repository, which we will refer to as 'DATA/path', then execute the following:
	Example Code
	`import lsst.daf.persistence as dafPersist`
	`butler = dafPersist.Butler(inputs='DATA/path')`
	Expected Result
	Butler repo available for reading.
	Actual Result
	Status: **Not Executed**

2	Description Point the butler to a simulated dataset containing data in all filters, that is sufficient for the purposes of measuring photometric performance metrics. Expected Result

	Actual Result
	Status: **Not Executed**
3	Description Execute the LSST Stack package 'validate_drp' (or an alternate package that is relevant) on this dataset to perform the measurements of the metrics.
	Expected Result Measurements of validation metrics and the presence of QA plots resulting from the validation pipeline.
	Actual Result
	Status: **Not Executed**
4	Description Compare measured photometry to known values from input simulated data, and confirm that the output values for all of the photometric performance metrics are as expected.
	Expected Result Measured astrometry metrics that are within reasonable values given the (known) input dataset.
	Actual Result
	Status: **Not Executed**

5.1.3.8 Test Case LVV-T376 - Verify the Calculation of Ellipticity Residuals and Correlations

Open *LVV-T376* test case in Jira.

Verify that the DMS includes software to enable the calculation of the ellipticity residuals and correlation metrics defined in the OSS.

Preconditions:

Execution status: **Not Executed**

Final comment:

Detailed steps results:

Step	Step Details

1	Description
	Identify the path to the data repository, which we will refer to as 'DATA/path', then execute the following:
	Example Code
	`import lsst.daf.persistence as dafPersist`
	`butler = dafPersist.Butler(inputs='DATA/path')`
	Expected Result
	Butler repo available for reading.
	Actual Result
	Status: **Not Executed**

2	Description Point the butler to an appropriate (precursor or simulated) dataset containing data in all filters, that is sufficient for the purposes of measuring astrometric performance metrics. Expected Result Actual Result Status: **Not Executed**
3	Description Execute the LSST Stack package 'validate_drp' (or an alternate package that is relevant) on this dataset to perform the measurements of the metrics. Expected Result Measurements of validation metrics and the presence of QA plots resulting from the validation pipeline. Actual Result Status: **Not Executed**
4	Description

Compare measured ellipticity correlations to known (for simulated data) or measured (if using precursor data) values from input (precursor or simulated) data, and confirm that the output values for all of the ellipticity performance metrics are as expected.

Expected Result

Measured ellipticity metrics that are within reasonable values given the (known) input dataset.

Actual Result

Status: **Not Executed**

5.1.3.9 Test Case LVV-T28 - Verify implementation of Measurements in catalogs

Open *LVV-T28* test case in Jira.

Verify that source measurements in catalogs are in flux units.

Preconditions:

Execution status: **Not Executed**

Final comment:

Detailed steps results:

Step	Step Details

1	Description
	Identify the path to the data repository, which we will refer to as 'DATA/path', then execute the following:
	Example Code
	`import lsst.daf.persistence as dafPersist`
	`butler = dafPersist.Butler(inputs='DATA/path')`
	Expected Result
	Butler repo available for reading.

	Actual Result
	Status: **Not Executed**
2	Description Identify and read appropriate processed precursor datasets with the Butler, including one containing single-visit images, one with coadds, and one with difference imaging.
	Expected Result
	Actual Result
	Status: **Not Executed**
3	Description Verify that each of the single-visit, coadd, and difference image catalogs provide measurements in flux units.
	Expected Result Confirmation of measurements in catalogs encoded in flux units.
	Actual Result
	Status: **Not Executed**

5.1.3.10 Test Case LVV-T43 - Verify implementation of Background Model Calculation

Open *LVV-T43* test case in Jira.

Verify that Processed Visit Images produced by the DRP and AP pipelines have had a model of the background subtracted, and that this model is persisted in a way that permits the background subtracted from any CCD to be retrieved along with the image for that CCD.

Preconditions:

Execution status: **Not Executed**

Final comment:

Detailed steps results:

Step	Step Details
1	Description Identify a dataset with processed visit images in multiple filters. Expected Result Actual Result Status: **Not Executed**

2	Description
	Identify the path to the data repository, which we will refer to as 'DATA/path', then execute the following:
	Example Code
	`import lsst.daf.persistence as dafPersist`
	`butler = dafPersist.Butler(inputs='DATA/path')`
	Expected Result
	Butler repo available for reading.
	Actual Result
	Status: **Not Executed**

3	Description Display an image of the background model for a full CCD. Repeat this for all available filters, and confirm that the background is smoothly varying and defined over the full CCD. Expected Result Well-formed background covering the entire CCD for all CCDs in all filters. Actual Result Status: **Not Executed**

A Traceability

Test Case	VE Key	VE Summary
LVV-T28	LVV-178	DMS-REQ-0347-V-01: Measurements in catalogs
LVV-T40	LVV-13	DMS-REQ-0030-V-01: Absolute accuracy of WCS
LVV-T41	LVV-30	DMS-REQ-0070-V-01: Generate PSF for Visit Images
LVV-T43	LVV-158	DMS-REQ-0327-V-01: Background Model Calculation
LVV-T62	LVV-20	DMS-REQ-0047-V-01: Provide PSF for Coadded Images
LVV-T132	LVV-127	DMS-REQ-0296-V-01: Pre-cursor, and Real Data
LVV-T376	LVV-3404	DMS-REQ-0362-V-01: Median residual PSF ellipticity correlations on 5 arcmin scales
	LVV-9780	DMS-REQ-0362-V-02: Max fraction of excess ellipticity residuals on 1 and 5 arcmin scales
LVV-T377	LVV-3401	DMS-REQ-0359-V-01: RMS photometric repeatability in uzy
	LVV-9751	DMS-REQ-0359-V-02: Max fraction of sensors with excess unusable pixels
	LVV-9757	DMS-REQ-0359-V-08: Max cross-talk imperfections
	LVV-9755	DMS-REQ-0359-V-06: Accuracy of photometric transformation
	LVV-9754	DMS-REQ-0359-V-05: Repeatability outlier limit in gri
	LVV-9752	DMS-REQ-0359-V-03: Max fraction of outliers among non-saturated sources
	LVV-9756	DMS-REQ-0359-V-07: RMS width of zero point in u-band
	LVV-9753	DMS-REQ-0359-V-04: Accuracy of zero point for colors with u-band
	LVV-9762	DMS-REQ-0359-V-13: Max sky brightness error
	LVV-9760	DMS-REQ-0359-V-11: Fraction of zero point outliers
	LVV-9759	DMS-REQ-0359-V-10: RMS photometric repeatability in gri

	LVV-9758	DMS-REQ-0359-V-09: Repeatability outlier limit in uzy
	LVV-9761	DMS-REQ-0359-V-12: Max fraction of unusable pixels per sensor
	LVV-9764	DMS-REQ-0359-V-15: Percentage of image area with ghosts
	LVV-9766	DMS-REQ-0359-V-17: Max RMS of resolved/unresolved flux ratio
	LVV-9763	DMS-REQ-0359-V-14: RMS width of zero point in all bands except u
	LVV-9765	DMS-REQ-0359-V-16: Accuracy of zero point for colors without u-band
LVV-T378	LVV-3402	DMS-REQ-0360-V-01: Median astrometric error on 20 arcmin scales
	LVV-9778	DMS-REQ-0360-V-12: RMS difference between r-band and other filter separation
	LVV-9777	DMS-REQ-0360-V-11: Max fraction of r-band color difference outliers
	LVV-9779	DMS-REQ-0360-V-13: Max fraction exceeding limit on 200 arcmin scales
	LVV-9773	DMS-REQ-0360-V-07: Outlier limit on 5 arcmin scales
	LVV-9770	DMS-REQ-0360-V-05: Outlier limit on 20 arcmin scales
	LVV-9775	DMS-REQ-0360-V-09: Outlier limit on 200 arcmin scales
	LVV-9769	DMS-REQ-0360-V-04: Median absolute error in RA, Dec
	LVV-9774	DMS-REQ-0360-V-08: Median astrometric error on 200 arcmin scales
	LVV-9768	DMS-REQ-0360-V-03: Median astrometric error on 5 arcmin scales
	LVV-9771	DMS-REQ-0360-V-06: Color difference outlier limit relative to r-band
	LVV-9776	DMS-REQ-0360-V-10: Max fraction exceeding limit on 20 arcmin scales

	LVV-9767	DMS-REQ-0360-V-02: Max fraction exceeding limit on 5 arcmin scales
LVV-T1240	LVV-9741	DMS-REQ-0030-V-02: Minimum astrometric standards per CCD

B Acronyms used in this document

Acronym	Description
AP	Alert Production
CCD	Charge-Coupled Device
CI	Cyber Infrastructure
DM	Data Management
DMS	Data Management Subsystem
DMS-REQ	Data Management System Requirements prefix
DMSR	DM System Requirements; LSE-61
DMTR	DM Test Report
DRP	Data Release Production
FITS	Flexible Image Transport System
HSC	Hyper Suprime-Cam
LDF	LSST Data Facility
LDM	LSST Data Management (Document Handle)
LSE	LSST Systems Engineering (Document Handle)
LSP	LSST Science Platform
LSST	Large Synoptic Survey Telescope
NCSA	National Center for Supercomputing Applications
OSS	Observatory System Specifications; LSE-30
PSF	Point Spread Function
QA	Quality Assurance
RA	Right Ascension
RMS	Root-Mean-Square
WCS	World Coordinate System
arcmin	arcminute minute of arc (unit of angle)