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Vera C. Rubin Observatory
Data Management

Characterization Metric Report: Science Pipelines Version 20.0.0

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DMTR-251

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D R A F T

Abstract

This brief report describes measurements of interest that were carried out for re-
lease v20.0.0 of the Science Pipeline. The report for the previous version can be
found in [DMTR-191].

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Contents

Characterization Metric Report: Science Pipelines Version 20.0.0

The Characterization Metric Report that has accompanied previous releases of the Science Pipelines (through v19.0) has typically contained metrics that were measured using validation_data_hsc. This test dataset consists of 8 HSC engineering images: 2 *r*-band, 4 *i*'-band, and 2 *y*-band. For continuity with previous releases, we report metrics from validation_data_hsc in this document, but we will use a more substantial dataset for characterization of future releases. For this small dataset, metric measurements were made on individual, separately-processed, single-frame images: jointcal was not run. All values were computed using the `examples/runHscTest.sh` script in the validate_drp package.

In this report, we also show metrics measured on the HSC-RC2 dataset. RC2 consists of 3 tracts of data taken from the HSC-SSP survey, and selected to provide a means of testing various "pathological" cases (e.g., difficult astrometric solutions, seeing too small to provide a well-sampled PSF, difficult fields for deblending, and large galaxies, among others). These three tracts each contain between 112–149 visits split between the HSC-G, HSC-R, HSC-I, HSC-Z, and HSC-Y (*grizy*) filters. The validate_drp scripts were run on these tracts to derive a total of 14 photometric, astrometric, and shape metrics, a subset of which are reported here. We exclude the three astrometry metrics (AM3, AD3, and AF3) that concern residuals on 200-arcminute scales, since neither the handful of CCDs in the validation_data_hsc dataset nor the individual tracts of RC2 span large enough spatial scales to enable these measurements. The RC2 data processing includes jointcal, and thus provides a better representation of the state of the science pipelines than the much simpler validation_data_hsc runs.

For comparison, we provide the SRD required "design" value of each metric as defined in the Science Requirements Document [LPM-17], and, where available, the target for this release as defined in the Data Management Development Milestone Roadmap [LDM-240]. For context, the SRD does not place any constraints on *y*-band for these Key Performance Metrics (KPMs). For the photometric metrics, there are only specifications for *g*, *r*, and *i*'. In the case of the ellipticity correlation metrics, there are specs only for *r* and *i*'. The *y*-band measurements are of interest primarily for historical tracking.

Some KPMs (AF1, AD1) involve thresholds that are different for "design", "minimum", and "stretch" specifications. The metrics in this report are all compared to the "design" thresholds. The assessment of these KPMs would be different if evaluated against different thresholds.

The per-cycle target numbers come from the "KPMs" sheet of LDM-240.

1   Dashboard summary of performance metrics

Metrics are typically monitored on a dashboard hosted by SQuaSH (Science Quality System Harness; described in [SQR-009]). Here we show an example of this dashboard displaying ∼ 4 months of measurements for a few metrics. These measurements are for tract 9813, as measured in the *r*-band filter (HSC-R). Note that the large increase between April-June was due to some bugs and issues in the codebase that have since been identified and fixed. The metric values in the most recent processing (with the v20.0 release candidate dubbed v20_0_0_rc1) have returned to similar levels to early 2020.

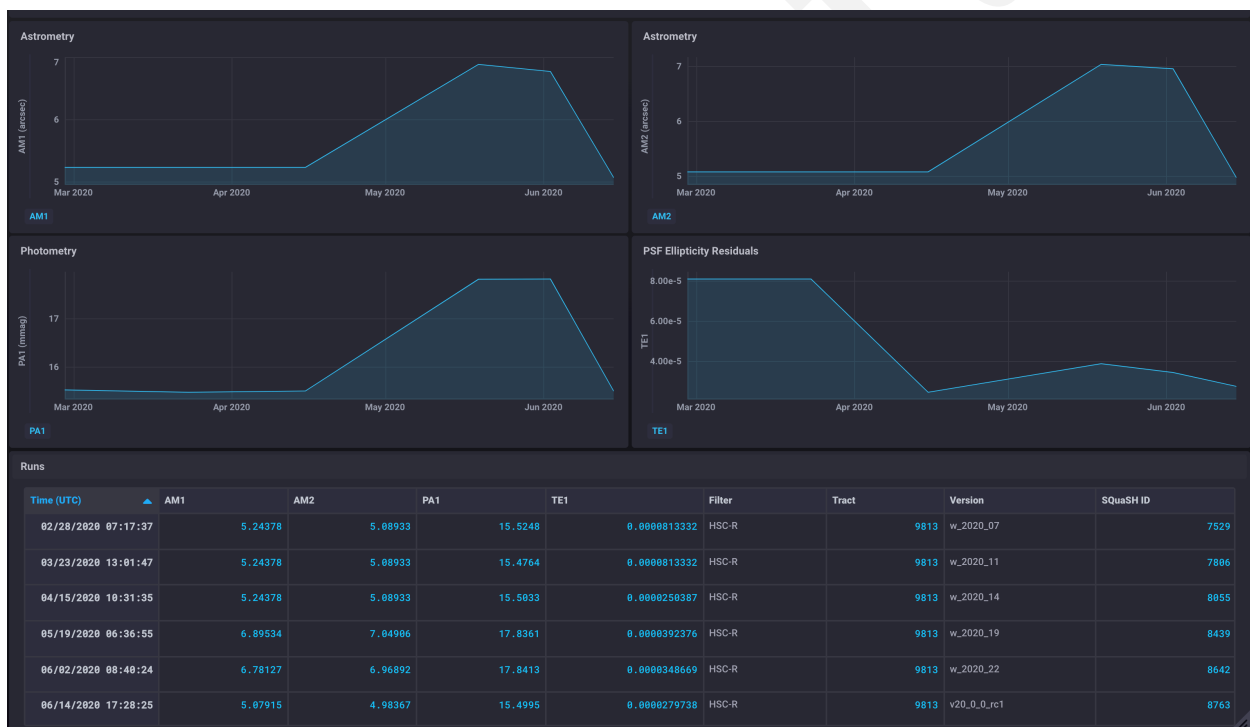FIGURE 1: SQuaSH dashboard showing the past four months of metric measurements from the RC2 dataset. This view shows the metrics for tract 9813 in the HSC-R filter. The "regression" in the metrics from April-June was due to some bugs and configuration changes. After all of these were repaired, the metric values as calculated by the v20.0 science pipelines returned to the levels they were at before those bugs.

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2 Photometric Performance

procCalRep corresponds to requirement OSS-REQ-0275 (defined in LSE-30). All other photometric performance metrics follow LSS-REQ-0093 (LSE-29) and Table 14 of LPM-17.

Any entries left blank are those for which we do not have data in the given filter for that dataset.

Metric	Unit	SRD Requirement – Design	Release 20 Target	Value (validation data)	Value (RC2)	Comments
procCalRep	mmag	≤ 3.0	3.5	—	—	Need simulations
PA1: u	mmag	≤ 7.5	8.0	—	—	No data
PA1: g	mmag	≤ 5.0	5.5	—	12.7	
PA1: r	mmag	≤ 5.0	5.5	13.7	14.1	
PA1: i	mmag	≤ 5.0	5.5	12.1	14.0	
PA1: z	mmag	≤ 7.5	8.0	—	11.6	
PA1: y	mmag	≤ 7.5	8.0	23.8	13.5	
PF1: u	%	≤ 20	20.0	—	—	No data
PF1: g	%	≤ 20	20.0	—	28.6	
PF1: r	%	≤ 10	10.0	30.1	31.1	
PF1: i	%	≤ 10	10.0	25.9	31.7	
PF1: z	%	≤ 20	20.0	—	13.2	
PF1: y	%	≤ 10	10.0	34.7	16.6	
PA2: u	%	≤ 22.5	—	—	—	No data
PA2: g	%	≤ 15	—	—	27.9	
PA2: r	%	≤ 15	20.0	26.6	29.8	
PA2: i	%	≤ 15	20.0	25.4	29.7	
PA2: z	%	≤ 22.5	—	—	25.5	
PA2: y	%	≤ 22.5	22.5	41.3	29.6	

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3 Astrometric Performance

The following metrics are defined following LSR-REQ-0094 [LSE-29] and Table 18 of LPM-17.

Metric	Unit	SRD Requirement – Design	Release 20 Target	Value (validation data)	Value (RC2)	Comments
AM1: u	mas	≤ 10	15.0	—	—	No data
AM1: g	mas	≤ 10	15.0	—	4.9	
AM1: r	mas	≤ 10	15.0	5.2	5.2	
AM1: i	mas	≤ 10	15.0	9.3	4.5	
AM1: z	mas	≤ 10	15.0	—	4.8	
AM1: y	mas	≤ 10	15.0	8.5	6.7	
AF1: u	%	≤ 10	10.0	—	—	No data
AF1: g	%	≤ 10	10.0	—	0.4	
AF1: r	%	≤ 10	10.0	0.7	1.4	
AF1: i	%	≤ 10	10.0	2.1	0.5	
AF1: z	%	≤ 10	10.0	—	0.5	
AF1: y	%	≤ 10	10.0	3.6	2.8	
AD1: u	mas	≤ 20	20.0	—	—	No data
AD1: g	mas	≤ 20	20.0	—	5.9	
AD1: r	mas	≤ 20	20.0	8.2	7.4	
AD1: i	mas	≤ 20	20.0	10.8	5.7	
AD1: z	mas	≤ 20	20.0	—	6.7	
AD1: y	mas	≤ 20	20.0	13.2	11.3	
AM2: u	mas	≤ 10	15.0	—	—	No data
AM2: g	mas	≤ 10	15.0	—	5.0	
AM2: r	mas	≤ 10	15.0	5.3	6.4	
AM2: i	mas	≤ 10	15.0	9.4	4.4	
AM2: z	mas	≤ 10	15.0	—	5.0	
AM2: y	mas	≤ 10	15.0	8.9	6.8	
AF2: u	%	≤ 10	10.0	—	—	No data
AF2: g	%	≤ 10	10.0	—	0.5	
AF2: r	%	≤ 10	10.0	0.6	1.1	
AF2: i	%	≤ 10	10.0	1.7	0.7	
AF2: z	%	≤ 10	10.0	—	0.5	

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Metric	Unit	SRD Requirement – Design	Release 20 Target	Value (validation data)	Value (RC2)	Comments
AF2: *y*	%	≤ 10	10.0	3.6	2.7	
AD2: *u*	mas	≤ 20	20.0	—	—	No data
AD2: *g*	mas	≤ 20	20.0	—	5.7	
AD2: *r*	mas	≤ 20	20.0	8.5	6.8	
AD2: *i*	mas	≤ 20	20.0	10.2	5.7	
AD2: *z*	mas	≤ 20	20.0	—	6.0	
AD2: *y*	mas	≤ 20	20.0	13.4	10.6	

Almost all of the astrometric metrics are improved with RC2 relative to their values with validation_data_hsc. This behavior is expected, because validate_drp does not include running jointcal, while the RC2 processing does include jointcal. This results in improved astrometry because (1) jointcal simultaneously fits positions of objects in all visits, and (2) RC2 contains more visits, which allows for improvement in the statistical noise of astrometry measurements.

4   Ellipticity Correlations

The following metrics are defined following LSR-REQ-0097 [LSE-29] and Table 27 of LPM-17.

Metric	Unit	SRD Requirement – Design	Release 20 Target	Value (validation data)	Value (RC2)	Comments
TE1: *u*	—	$\leq 2 \times 10^{-5}$	2×10^{-5}	—	—	No data
TE1: *g*	—	$\leq 2 \times 10^{-5}$	2×10^{-5}	—	1.4×10^{-5}	
TE1: *r*	—	$\leq 2 \times 10^{-5}$	2×10^{-5}	1.6×10^{-5}	2.0×10^{-5}	
TE1: *i*	—	$\leq 2 \times 10^{-5}$	2×10^{-5}	8.8×10^{-7}	1.1×10^{-5}	
TE1: *z*	—	$\leq 2 \times 10^{-5}$	2×10^{-5}	—	1.6×10^{-5}	
TE1: *y*	—	$\leq 2 \times 10^{-5}$	2×10^{-5}	2.2×10^{-5}	9.3×10^{-6}	
TE2: *u*	—	$\leq 1 \times 10^{-7}$	2×10^{-7}	—	—	No data
TE2: *g*	—	$\leq 1 \times 10^{-7}$	2×10^{-7}	—	3.7×10^{-7}	

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Metric	Unit	SRD Requirement – Design	Release 20 Target	Value (validation data)	Value (RC2)	Comments
TE2: r	—	$\leq 1 \times 10^{-7}$	2×10^{-7}	2.7×10^{-7}	1.0×10^{-6}	
TE2: i	—	$\leq 1 \times 10^{-7}$	2×10^{-7}	7.1×10^{-7}	2.5×10^{-6}	
TE2: z	—	$\leq 1 \times 10^{-7}$	2×10^{-7}	—	5.0×10^{-7}	
TE2: y	—	$\leq 1 \times 10^{-7}$	2×10^{-7}	3.1×10^{-6}	1.2×10^{-6}	

5   Computational Performance

Computational performance metrics were not re-measured for this release.

A   References

[1] **[LSE-29]**, Claver, C.F., The LSST Systems Engineering Integrated Project Team, 2017, *LSST System Requirements (LSR)*, LSE-29, URL https://ls.st/LSE-29

[2] **[LSE-30]**, Claver, C.F., The LSST Systems Engineering Integrated Project Team, 2018, *Observatory System Specifications (OSS)*, LSE-30, URL https://ls.st/LSE-30

[3] **[SQR-009]**, Fausti, A., 2017, *The SQuaSH metrics dashboard*, SQR-009, URL https://sqr-009.lsst.io

[4] **[LPM-17]**, Ivezić, Ž., The LSST Science Collaboration, 2018, *LSST Science Requirements Document*, LPM-17, URL https://ls.st/LPM-17

[5] **[DMTR-191]**, J. Carlin, G.C., K. S. Krughoff, 2019, *Characterization Metric Report: Science Pipelines Version 19.0.0*, DMTR-191, URL http://dmtr-191.lsst.io

[6] **[LDM-240]**, Kantor, J., Jurić, M., Lim, K.T., 2016, *Data Management Releases*, LDM-240, URL https://ls.st/LDM-240

B   Acronyms

Acronym	Description
DM	Data Management
DMTR	DM Test Report
HSC	Hyper Suprime-Cam
HSC-SSP	Hyper Suprime-Cam Subaru Strategic Program
KPMs	Key Performance Metrics
LDM	LSST Data Management (Document Handle)
LPM	LSST Project Management (Document Handle)
LSE	LSST Systems Engineering (Document Handle)
LSR	LSST System Requirements; LSE-29
OSS	Observatory System Specifications; LSE-30
PSF	Point Spread Function
RC2	Release Candidate 2
SQuaSH	Science Quality Analysis Harness
SRD	LSST Science Requirements; LPM-17