



LARGE SYNOPTIC SURVEY TELESCOPE

Large Synoptic Survey Telescope (LSST)  
Data Management

# Characterization Metric Report: Science Pipelines Version 19.0.0

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**DRAFT**

## Abstract

This brief report describes measurements of interest that were carried out for release v19.0.0 of the Science Pipeline. The report for the previous version can be found in DMTR-141.



## Change Record

Version	Date	Description	Owner name
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Metrics were measured using `validation_data_hsc`, which consists of 8 HSC engineering images: 2 *r*-band, 4 *i'*-band, and 2 *y*-band. Measurements were made on individual, separately-processed, single-frame images: `jointcal` was not run. 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]. All values were computed using the `examples/runHscTest.sh` script in the `validate_drp` package. For context, the SRD does not place any constraints on *y*-band for these 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 for interest and historical tracking.

Some KPMs (AF1, AD1) involve thresholds that are different for “design”, “minimum”, and “stretch” specifications. Thus comparing one of these metrics against a given target number is a two-level process. Both the threshold used in the calculation and the requirement on the computed number are dependent on the specifications.

The metrics in this report have all been computed relative to the “design” thresholds. The values of these KPMs would be different if computed against different thresholds.

Note also that the photometric performance of the pipelines in the *y*-band is an under estimate of expected delivered performance. For these tests, the *y*-band data was calibrated with *z*-band photometry. This is due to the lack of a reference catalog containing *y*-band information at this time. We recognize that the bandpass mismatch is certainly not the only source of scatter in the *y*-band photometry. These metric measurements are still worth noting in this report as a historical benchmark to track relative performance.

Some of the Astrometric Performance measurements (Table 2) have increased since the previous pipeline release. This behavior is expected because we adopted a more accurate definition for calculating the RMS for the “AMx” metrics. Because our tests use few images (i.e., low *n*), the small correction in how we calculate RMS (adopting  $n/(n - 1) * np.std()$  for the unbiased sample standard deviation; see details in DM-18751) increases our estimates of “AMx.” However, this actually represents an *improvement* in our measurement of the performance that reveals we were not doing as well as we thought.

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

## 1 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 LPM-17 table 14.

Metric	Unit	SRD Requirement-Design	Release 19 Target	Value	Comments
procCalRep	mmag	$\leq 3.0$	4.0	—	Need simulations
PA1: <i>u</i>	mmag	$\leq 7.5$	8.0	—	No data
PA1: <i>g</i>	mmag	$\leq 5.0$	6.0	—	No data
PA1: <i>r</i>	mmag	$\leq 5$	6.0	14.3	
PA1: <i>i</i>	mmag	$\leq 5$	5.0	12.0	
PA1: <i>z</i>	mmag	$\leq 7.5$	8.0	—	No data
PA1: <i>y</i>	mmag	$\leq 7.5$	8.0	25.3	
PF1: <i>u</i>	%	$\leq 20$	—	—	No data
PF1: <i>g</i>	%	$\leq 20$	—	—	No data
PF1: <i>r</i>	%	$\leq 10$	10.0	30.9	
PF1: <i>i</i>	%	$\leq 10$	10.0	26.8	
PF1: <i>z</i>	%	$\leq 20$	—	—	No data
PF1: <i>y</i>	%	$\leq 10$	10.0	38.1	
PA2: <i>u</i>	mmag	$\leq 22.5$	—	—	No data
PA2: <i>g</i>	mmag	$\leq 15$	—	—	No data
PA2: <i>r</i>	mmag	$\leq 15$	20.0	27.2	
PA2: <i>i</i>	mmag	$\leq 15$	20.0	25.7	
PA2: <i>z</i>	mmag	$\leq 22.5$	—	—	No data
PA2: <i>y</i>	mmag	$\leq 22.5$	$\leq 22.5$	38.1	

## 2 Astrometric Performance

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

Metric	Unit	SRD Requirement- Design	Release 19 Target	Value
AM1: <i>r</i>	mas	$\leq 10$	20.0	5.15
AM1: <i>i</i>	mas	$\leq 10$	20.0	9.16
AM1: <i>y</i>	mas	$\leq 10$	20.0	8.28
AF1: <i>r</i>	%	$\leq 10$	10.0	0.63
AF1: <i>i</i>	%	$\leq 10$	10.0	1.78
AF1: <i>y</i>	%	$\leq 10$	10.0	2.96
AD1: <i>r</i>	mas	$\leq 20$	20.0	8.13
AD1: <i>i</i>	mas	$\leq 20$	20.0	10.30
AD1: <i>y</i>	mas	$\leq 20$	20.0	12.50
AM2: <i>r</i>	mas	$\leq 10$	20.0	5.28
AM2: <i>i</i>	mas	$\leq 10$	20.0	9.30
AM2: <i>y</i>	mas	$\leq 10$	20.0	9.08
AF2: <i>r</i>	%	$\leq 10$	10.0	0.65
AF2: <i>i</i>	%	$\leq 10$	10.0	01.61
AF2: <i>y</i>	%	$\leq 10$	10.0	3.96
AD2: <i>r</i>	mas	$\leq 20$	20.0	8.42
AD2: <i>i</i>	mas	$\leq 20$	20.0	9.96
AD2: <i>y</i>	mas	$\leq 20$	20.0	13.07

## 3 Ellipticity Correlations

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

Metric	Unit	SRD Requirement-Design	Release 19 Target	Value
TE1: <i>r</i>	—	$\leq 2 \times 10^{-5}$	$\leq 3 \times 10^{-5}$	$1.30 \times 10^{-5}$
TE1: <i>i</i>	—	$\leq 2 \times 10^{-5}$	$\leq 3 \times 10^{-5}$	$3.16 \times 10^{-6}$

Metric	Unit	SRD		
		Requirement-Design	Release 19 Target	Value
TE1: $y$	—	$\leq 2 \times 10^{-5}$	$\leq 3 \times 10^{-5}$	$2.39 \times 10^{-4}$
TE2: $r$	—	$\leq 1 \times 10^{-7}$	$\leq 3 \times 10^{-7}$	$3.77 \times 10^{-7}$
TE2: $i$	—	$\leq 1 \times 10^{-7}$	$\leq 3 \times 10^{-7}$	$5.23 \times 10^{-7}$
TE2: $y$	—	$\leq 1 \times 10^{-7}$	$\leq 3 \times 10^{-7}$	$2.39 \times 10^{-6}$

## 4 Computational Performance

Computational performance metrics were not re-measured for this release. We expect no significant changes relative to the report on version 12 [DMTR-15].

## 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] **[LPM-17]**, Ivezić, Ž., The LSST Science Collaboration, 2018, *LSST Science Requirements Document*, LPM-17, URL <https://ls.st/LPM-17>
- [4] **[LDM-240]**, Kantor, J., Jurić, M., Lim, K.T., 2016, *Data Management Releases*, LDM-240, URL <https://ls.st/LDM-240>
- [5] **[DMTR-141]**, on behalf of Science Pipelines Team, G.C., 2019, *Characterization Metric Report: Science Pipelines Version 18.0.0*, DMTR-141, URL <http://dmtr-141.lsst.io>
- [6] **[DMTR-15]**, Wood-Vasey, M., Swinbank, J., 2017, *Characterization Metric Report: Science Pipelines Version 13.0*, DMTR-15, URL <https://ls.st/DMTR-15>