

Large Synoptic Survey Telescope (LSST) Data Management

Characterization Metric Report: Science Pipelines Version 19.0.0

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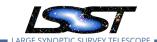
DMTR-191

Latest Revision: 2019-12-06

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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 |
|---------|------------|--|--------------|
| | 2019-11-26 | First Draft | G. Comoretto |
| 1.0 | 2019-12-05 | First issue after document approval DM- 22270 | J.Carlin |





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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.

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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 | ≤ 3.0 | 4.0 | - | Need |
| | | | | | simulations |
| PA1: <i>u</i> | mmag | ≤ 7.5 | 8.0 | _ | No data |
| PA1: <i>g</i> | mmag | ≤ 5.0 | 6.0 | _ | No data |
| PA1: <i>r</i> | mmag | ≤ 5 | 6.0 | 14.3 | |
| PA1: <i>i</i> | mmag | ≤ 5 | 5.0 | 12.0 | |
| PA1: <i>z</i> | mmag | ≤ 7.5 | 8.0 | _ | No data |
| PA1: <i>y</i> | mmag | ≤ 7.5 | 8.0 | 25.3 | |
| PF1: <i>u</i> | % | ≤ 20 | _ | _ | No data |
| PF1: <i>g</i> | % | ≤ 20 | | _ | No data |
| PF1: <i>r</i> | % | ≤ 10 | 10.0 | 30.9 | |
| PF1: <i>i</i> | % | ≤ 10 | 10.0 | 26.8 | |
| PF1: <i>z</i> | % | ≤ 20 | _ | | No data |
| PF1: <i>y</i> | % | ≤ 10 | 10.0 | 38.1 | |
| PA2: <i>u</i> | mmag | ≤ 22.5 | _ | _ | No data |
| PA2: <i>g</i> | mmag | ≤ 15 | _ | _ | No data |
| PA2: <i>r</i> | mmag | ≤ 15 | 20.0 | 27.2 | |
| PA2: <i>i</i> | mmag | ≤ 15 | 20.0 | 25.7 | |
| PA2: <i>z</i> | mmag | ≤ 22.5 | _ | _ | No data |
| PA2: <i>y</i> | mmag | ≤ 22.5 | ≤ 22.5 | 38.1 | |

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2 Astrometric Performance

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

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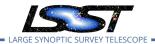
| Metric | Unit | SRD Requirement– Design | Release 19 Target | Value |
|---------------|------|-------------------------------|-------------------|-------|
| AM1: <i>r</i> | mas | ≤ 10 | 20.0 | 5.15 |
| AM1: <i>i</i> | mas | ≤ 10 | 20.0 | 9.16 |
| AM1: <i>y</i> | mas | ≤ 10 | 20.0 | 8.28 |
| AF1: <i>r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

3 Ellipticity Correlations

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

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

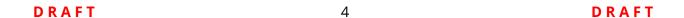
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| | | SRD | | |
|---------------|------|-------------------------|-------------------------|-----------------------|
| Metric | Unit | Requirement-Design | Release 19 Target | Value |
| TE1: <i>y</i> | _ | $\leq 2 \times 10^{-5}$ | $\leq 3 \times 10^{-5}$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

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