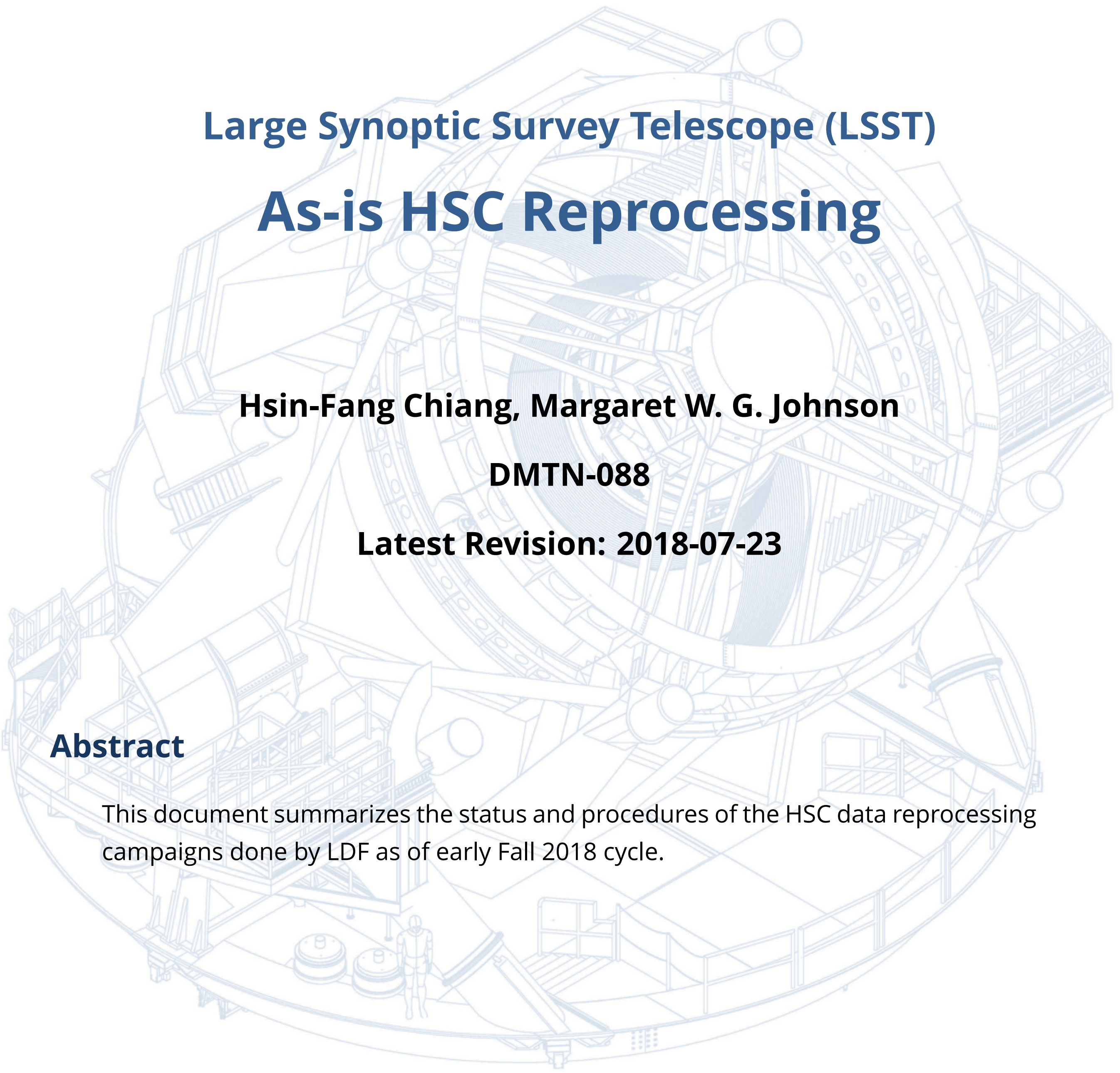
LARGE SYNOPTIC SURVEY TELESCOPE



Large Synoptic Survey Telescope (LSST)

As-is HSC Reprocessing

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DMTN-088

Latest Revision: 2018-07-23

Abstract

This document summarizes the status and procedures of the HSC data reprocessing campaigns done by LDF as of early Fall 2018 cycle.

Change Record

Version	Date	Description	Owner name
1	YYY-MM-DD	Unreleased.	Hsin-Fang Chiang

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As-is HSC Reprocessing

In this document, we summarize the current status and operational processes of the Hyper Suprime-Cam (HSC) data reprocessing campaigns offered by the LSST Data Facility (LDF) as part of the Batch Production Services. We describe the service as is in the early Fall 2018 cycle, but expect the detailed procedures to evolve with the continuing development and the maturing service.

1 Goals

The main goal of reprocessing HSC data using LSST Science Pipelines is to generate a validation dataset for tests and integration, both scientifically and operationally, and to regularly scrutinize for any data or science issues. Besides allowing to track any quality or performance changes as the pipeline evolves, the processed dataset serves as a base set of data products with which the developers can test a specific component of the science pipelines without the need to reprocess from raw files, or to test a new tool using state-of-the-art data products.

Additionally, the reprocessing helps to stress and validate the infrastructure (both software and hardware) with current science payload, to provide feedback on operational feasibility of all current aspects of the system in use, to explore possible operational strategies, and to mature the policies and procedures of the Batch Processing Service.

Currently, the HSC reprocessing campaigns are performed at two scales: (1) the RC scale, and (2) the PDR1 scale; more details are described in §2 and §3. Recent releases of the Data Release Production (DRP) pipelines are used. In general, campaigns are characterized by their goals, inputs (data, calibrations, codes, and configurations), and cadence.

2 RC-scale reprocessing

The input data are the HSC "RC2" dataset, which includes 3 tracts of public data and was selected to cover a wide range of data quality and observing conditions (DM-11345). It contains about 8% of the full HSC PDR1 dataset (§3).

A calendar-based schedule is used to run a "mini-DRP" with this RC2 dataset once every two weeks. This repeated reprocessing allows continuous testing and validation of Data Release Production algorithms.

Even-number weekly stack releases, provided automatically by the LSST DM Build system and installed by John Swinbank in the designated software area on the LSST GPFS (`/software`), are utilized. To prepare each campaign, the operations staff (1) verifies the software release was successfully built and installed on GPFS, (2) verifies the continuous integration package `ci_hsc` can run successfully, (3) evaluates changes to the stack release compared to the last campaign, and (4) confirms resource availability on LSST batch cluster and storage. Unless otherwise agreed between the DRP and LDF teams before launching the campaign, the default algorithmic configurations are used for the pipelines, as specified in the config files or source codes in the software stack.

Currently a mini-DRP workflow includes the following top-level pipelines: `makeSkyMap.py`, `singleFrameDriver.py`, `mosaic.py`, `skyCorrection.py`, `coaddDriver.py`, and `multiBandDriver.py`. Most frontend codes exist in the `pipe_drivers` package and are based on the `ctrl_pool`-style framework. We intend to move away from the `ctrl_pool`-style framework and work towards a production system; however, the transition is blocked by the Gen3 Butler/Middleware delivery and conversion of pipelines to the new middleware framework.

To monitor and verify if runs are successful, the job status and output data products are checked. Failures are characterized and handled as described in §4.

Generated data products include single frame processing products, coaddition products, and multiband products, and, upon successful completion of a campaign, are made available through the LSST developer infrastructure at NCSA. For HSC processing campaigns, LDF currently manages derived datasets as a site file system; individuals files are managed by users. When we transition to formal production processing of LSST data, LDF will be responsible for managing the location, metadata and provenance records of each file, and production data will be centrally managed in the Data Backbone. Results of the four most recent successful runs are retained. Datasets are disposed of after they are superseded by the next campaign.

Currently, though temporarily, some QC/QA prototype pipelines from the `pipe_analysis` and `validate_drp` packages are included in the biweekly runs. The `pipe_analysis` package is not in the official stack of `lsst_distrib` and was not designed to be included in the official stack in the first place; however, its outputs are essential for pipeline development and QA work (DMTN-074) and no replacement is available yet at time of writing. Neither `pipe_analysis` nor `validate_drp` follow the standard `pipe_base` `CmdLineTask` framework or the standard Butler usage for data IO.

How the these QC/QA packages will evolve in the long term is a subject of discussions in DMLT and the QA working group (LDM-622, RFC-476). When the DM-wide QC/QA plans are clarified, we will run only the QC/QA packages blessed officially. Before such a plan exists and the packages are standardized, the operations staff will work closely with the specific pipeline owners (Table 1) for emergent issues, and remove problematic QC/QA pipelines from the campaign as necessary (also see §4). As QC output products are not as well-defined, the operations staff does not track down individual outputs until the official products are formally defined and documented, and consider the jobs done as long as no fatal errors appear. In the short term, adding automatic CI tests for any QC pipelines, such as running `pipe_analysis` in the `ci_hsc` package, can reduce obvious breakages.

3 PDR1-scale reprocessing

On a per request basis and as deemed necessary, LDF reprocesses the full HSC PDR1 (Public Data Release 1[1]) dataset with a up-to-date DRP workflow and a recent software stack. The reprocessing campaign happens approximately annually. This dataset includes 5654 raw visits in 7 bands and 3 layers (WIDE, DEEP, UDEEP). This covers 119 tracts in the sky.

With the input ~13 times larger than the RC2 dataset, the PDR1-scale reprocessing helps identifying edge cases and bugs that do not appear in the small dataset. Developers needing more than a few tracts of data for testing algorithms also use the large processed dataset. The processed dataset is also potentially useful for PDAC testing, EPO development, or science verification activities by the commissioning team.

Software version, configurations, and other processing details that affect the scientific output products are decided between the DRP and LDF teams before the start of the run. A RC-scale run with the same setup precedes the PDR1-scale run to integrate and verify the components and configurations are nominally ready for bulk processing. Outputs of the RC-scale run allows QA work and important bug fixes before effort is spent in the large campaign. Typically,

[1] `https://hsc-release.mtk.nao.ac.jp/`

a few iterations are involved before the software is finalized and "frozen" for the processing campaign.

Procedures for monitoring and verifying these larger campaigns are similar to the biweekly campaigns. During the campaign, some computing and storage resources are reserved for the campaign use. Completion of these larger campaigns is announced on the LSST Community forum for broader consumption beyond the DM team. The output data products are protected against changes or disasters. Results of the two most recent successful runs are retained. Old data products are disposed before the third campaign starts.

4 As-is mitigation procedures in irregular scenarios

Sometimes, things don't go as smoothly as hoped. Here we describe some common scenarios and the as-is procedures for handling the problems.

- **Weekly release is not available in the shared stack at /software: wait patiently**

  If a weekly stack is not released or tagged in eups, I wait quietly; usually Josh Hoblitt (SQuaRE) would be already aware and working on it. If the weekly release has been eups-tagged successfully but the installation in the `/software` shared stack fails, I notify John Swinbank. Currently the LDF team is investigating using Singularity containers for the science payload; this would break the current dependency on shared stack installation.

- **Failures in building the non-official packages: file a JIRA ticket**

  Until 2018-03-31, two packages, `meas_mosaic` and `pipe_analysis`, needed to be updated and built manually. If they cannot be built, for example because the unit tests of `meas_mosaic` failed, a ticket will be filed so the DRP team can fix it. Meanwhile the first processing step which does not need `meas_mosaic` could start. Since `w_2018_13`, `meas_mosaic` has been added to be part of the `lsst_distrib` weekly release. So only one package, `pipe_analysis`, needs special care.

- **Operator user errors: operator's responsibility**

  The DRP workflow in the current system implies a science workflow and there are implicit dependencies in job execution. Currently, this level of workflow is taken care of by the operator manually. If the implicit workflow is not respected, necessary inputs of a job may not be available, so the output products would not be produced correctly, possibly without clear errors in the execution logs. It's the operator's responsibility to shepherd the workflow. Other operator errors include specifying output location improperly, overwriting files incorrectly, operator-introduced race condition, and so on. Some operations require knowledge in Butler and task framework implementations so misunderstanding of the framework can lead to mistakes as well. Many of these errors can be minimized once a real production system, including file management, is in use. The pipeline specification definition is also a design goal of the Gen3 Middleware.

- **Transient failures of the processing jobs due to hardware issues: LDF handles it**

  Hardware or network glitches such as temporary file system unavailability or a faulty node can fail jobs. The operator contacts the infrastructure team and creates IHS tickets as needed. Once the system is back to stable, the same job will be re-submitted. Choosing the operational setup wisely is operator's responsibility. For example, inferior specifications in computing resource need can lead to insufficient memory, timeout, job lingering forever, or other problems.

- **Reproducible fatal errors from the pipeline: report, apply fix if available quickly**

  Occasionally, the weekly stack is broken and does not allow the job to finish. The operations staff will verify if the failure is reproducible, and report to the Slack channel #dm-hsc-reprocessing for the DRP team or the specific pipeline owners (Table 1) to respond. Jira tickets containing the error messages will be filed, and the operations staff can then choose to abort the part of the campaign that depend on the data from the failed pipelines. Sometimes the bug is obvious, such as one from recent API changes or new features not caught by the standard CI tools; in this case a fix can be available quickly especially with the help of the developer who added the new feature. If a fix is available within a day, the operations staff may continue the execution using a new software version with the fix applied. If the fix is not available shortly, the operations staff may pause or cancel the campaign. (At the time of writing, no biweekly campaign has been aborted so far despite the occasional fatal bugs; developers have been helpful.)

- **Reproducible non-fatal errors from the pipeline: carry on without changes**

  Errors that are not in the FATAL-level do not stop the execution. Processing continue with the same software. Currently some harmless errors appear in the logs and not all errors are carefully vetted. Only severe errors that prevent further execution of the pipelines stop a processing campaign, despite the outputs may or may not be scientifically useful. In the future, the formal QC pipelines will be helpful to provide scientific metrics of the data products during the campaign execution, and may provide additional feedbacks on whether a campaign needs to be paused or specific inputs need to be removed. Currently, only QC metrics from the single frame processing are uploaded to the SQuaSH dashboard [2]; further QC metrics will be calculated and uploaded once the responsible pipelines are ready.

A Current Science Pipelines Payload

In Table 1, we list the pipelines currently included in the biweekly campaigns (§2) and their corresponding contacts. The contact may delegate the debugging responsibility to other team members.

TABLE 1: Pipelines currently included in biweekly RC reprocessing

package	pipeline	contact
pipe_tasks	`makeSkyMap.py`	Jim Bosch
pipe_drivers	`singleFrameDriver.py`	Jim Bosch
pipe_drivers	`skyCorrection.py`	Jim Bosch
meas_mosaic	`mosaic.py`	Jim Bosch
pipe_drivers	`coaddDriver.py`	Jim Bosch
pipe_drivers	`multiBandDriver.py`	Jim Bosch
pipe_analysis	`visitAnalysis.py`	Lauren MacArthur
pipe_analysis	`coaddAnalysis.py`	Lauren MacArthur
pipe_analysis	`colorAnalysis.py`	Lauren MacArthur
pipe_analysis	`compareVisitAnalysis.py`	Lauren MacArthur
pipe_analysis	`compareCoaddAnalysis.py`	Lauren MacArthur
validate_drp	`matchedVisitMetrics.py`	Michael Wood-Vasey
validate_drp	`validateDrp.py`	Michael Wood-Vasey
validate_drp	`reportPerformance.py`	Michael Wood-Vasey
verify	`dispatch_verify.py`	Angelo Fausti

References

[DMTN-074], Swinbank, J., 2018, *DM QA Status & Plans*, DMTN-074, URL `https://dmtn-074.lsst.io`,

[2] The metrics are uploaded to `https://squash.lsst.codes` using the `dispatch_verify.py` tool as listed in Table 1.

LSST Data Management Technical Note

[LDM-622], Swinbank, J., 2018, *Data Management QA Strategy Working Group Charge*, LDM-622, URL `https://ls.st/LDM-622`