



Synthetic Source Injection Workshop

Community Discussion on Future SSI

Lee Kelvin, Sophie Reed, Josh Meyers



U.S. DEPARTMENT OF
ENERGY

SLAC

CHARLES AND LISA SIMONYI FUND
••• FOR ARTS AND SCIENCES •••



Thurs, June 3, 2021

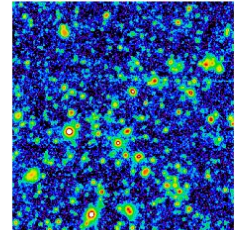
Welcome

Synthetic Source Injection (SSI / ‘fakes’) involves injecting synthetic sources (Sérsic, PSF, hydro cosmo sims, etc.) into raw science data and processing these data through to final imaging and catalogue outputs.

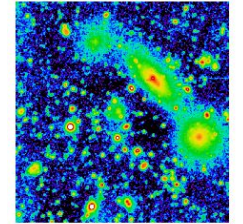
SSI provides invaluable information on sources where the ‘truth’ is known → analysis of these data helps us explore not only the accuracy of output source catalogs, but also the fidelity of associated data processing steps such as sky subtraction.

Synthetic Source Injection is becoming an increasingly important data analysis tool for a number of groups. As DM begin to consider future changes to our SSI framework, we’re keen to engage with the community on what kinds of SSI tools and data products we can provide to facilitate and support community efforts.

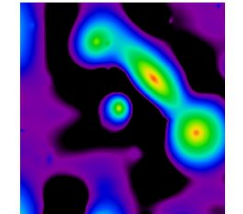
original



+SSI



difference



deepCoadd_calexp cutout,
tract 9813 patch 2,4 HSC-G

Workshop Goals

- To connect the various groups currently engaged in SSI using the science pipelines or working with HSC/DECam/DC2 imaging
- To learn more about processing details ongoing elsewhere
- To present Rubin Obs / DM current and future SSI plans
- To facilitate discussion on said plans, ensuring synthetic source datasets are maximally useful to community members and the science collaborations going forward

Key Discussion Points

- What kinds of regularly processed synthetic datasets would be most useful for DM to produce and supply to the community?
- Would any irregularly processed synthetic datasets also be useful?
- What metrics would be most useful for us to track on a regular basis?

Schedule

13:00 : Lee Kelvin

Welcome & workshop overview

13:05 : Sophie Reed

Current state of the Rubin science pipelines SSI code

13:10 : Josh Meyers

Recent DM source injection changes

13:15 : Spencer Everett

Balrog in DES Y3

13:30 : Chris Morrison

AP data quality testing needs for synthetic sources

13:45 : Matt Becker

Fake-source Injection for the DESC

14:00 : Boris Leistedt

SI plans in LSST DESC LSS

14:15 : Aaron Watkins

Assessing the impact of the pipeline sky subtraction on LSB science using model galaxies

14:30 : Song Huang

Lessons learned from Synpipe tests on HSC SSP data

14:45 : Break

14:50 : Lee Kelvin

Future synthetic source processing plans

15:00 : Discussion

Break out rooms if necessary

15:45 : Summary & Close

.....
Further discussion and Q&A:

- [#dm-ssi-workshop](#) in the LSSTC Slack
- <https://community.lsst.org/t/synthetic-source-injection-workshop-2021-06-03> on the Community Forum
- Zoom chat



Synthetic Source Injection Workshop

Current state of the Rubin science
pipelines SSI code

Sophie Reed



Thurs, June 3, 2021

Adding From Catalogues

See community post:

<https://community.lsst.org/t/new-tasks-for-fake-source-insertion>

(Or the DRPFakes pipeline in ci_hsc_gen3 for a gen3 example)

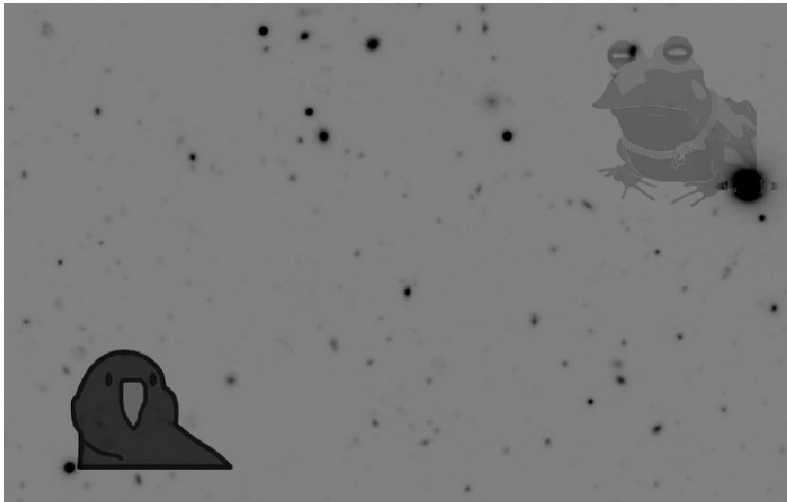
You can use a user defined catalogue of parameters to add sources.

- 1) Set up your catalogue
- 2) Run processCcdWithFakes (into visits) or insertFakes (into coadds)
- 3) Run the pipeline until the point you are interested in
- 4) Outputs are fakes_<normal datatype>

Adding Images

Cutout images can be of anything

Need to have a WCS attached



PSF
Convolution



QA Uses

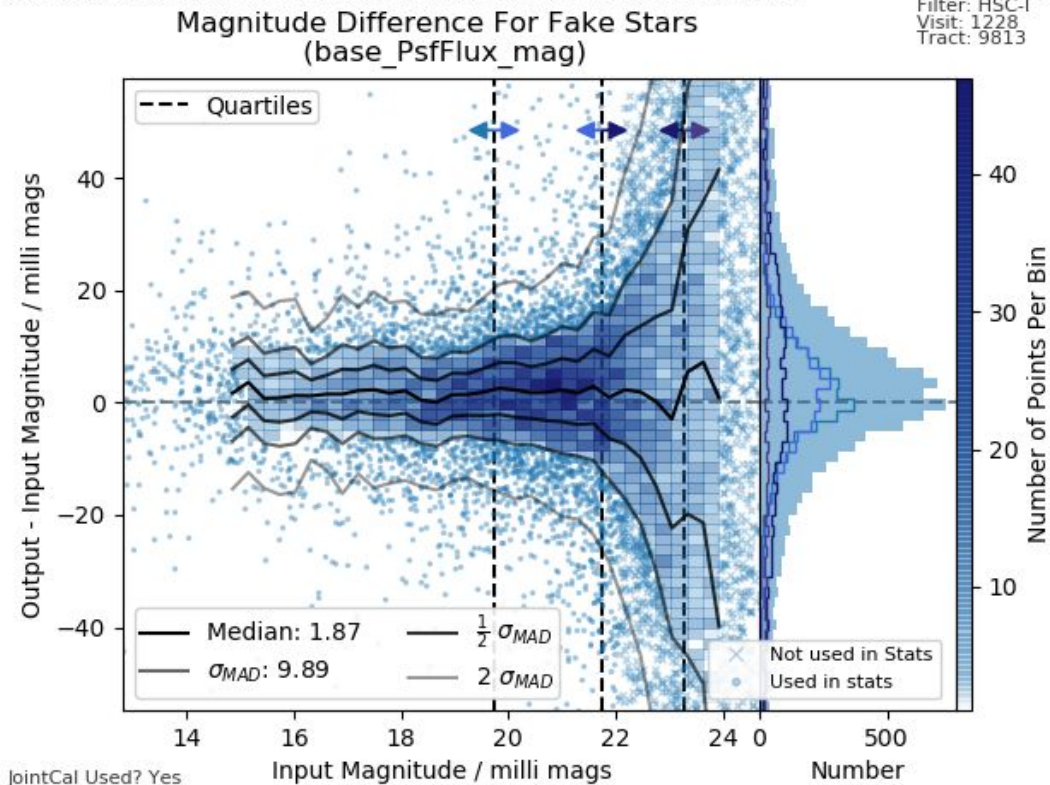
We can use these fakes to test the pipeline outputs.

This is the primary aim for DM.

Any plots that science users will really want to see?

rerun: /datasets/hsc/repo/rerun/private/sreed/hscRerun/cosmosFakes/testNewPlots

Camera: HSC
Filter: HSC-I
Visit: 1228
Tract: 9813



QA Uses

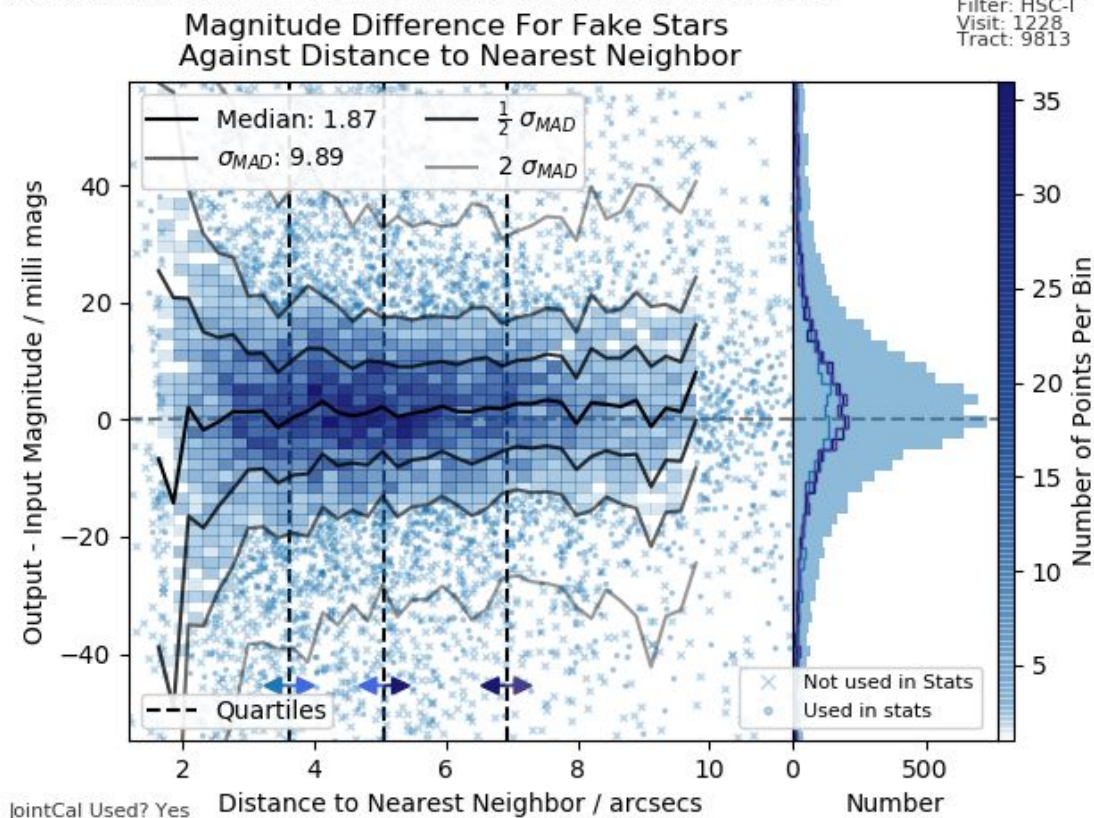
We can use these fakes to test the pipeline outputs.

This is the primary aim for DM.

Any plots that science users will really want to see?

rerun: /datasets/hsc/repo/rerun/private/sreed/hscRerun/cosmosFakes/testNewPlots

Camera: HSC
Filter: HSC-I
Visit: 1228
Tract: 9813



QA Uses

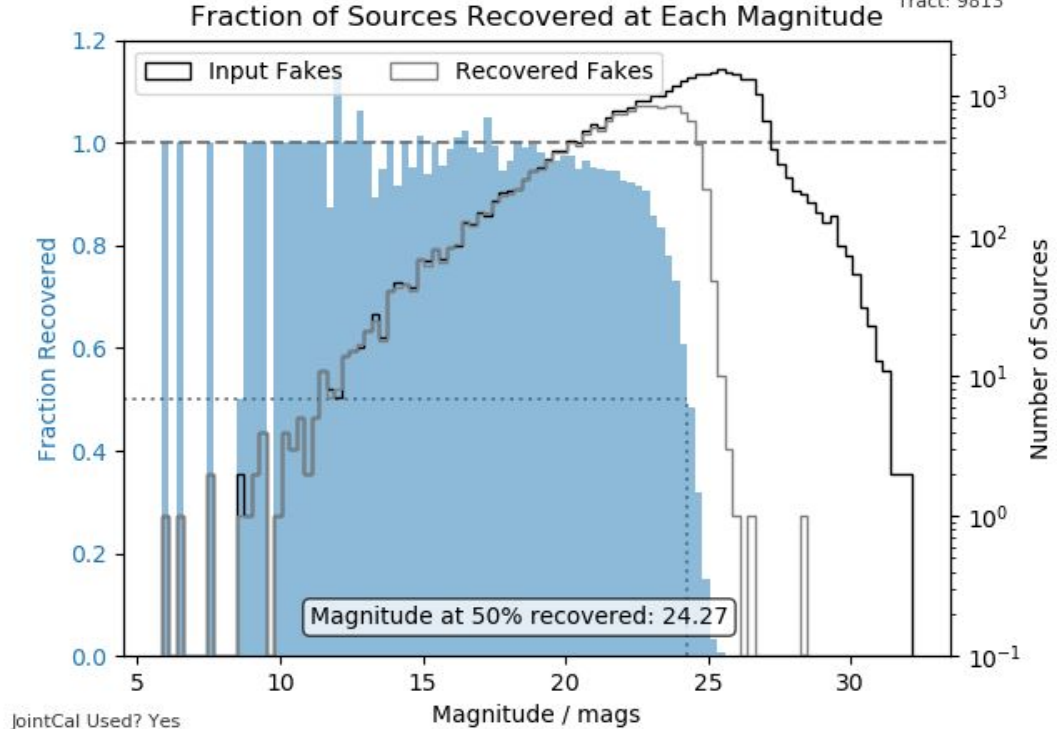
We can use these fakes to test the pipeline outputs.

This is the primary aim for DM.

Any plots that science users will really want to see?

rerun: /datasets/hsc/repo/rerun/private/sreed/hscRerun/cosmosFakes/testNewPlots

Camera: HSC
Filter: HSC-I
Visit: 1228
Tract: 9813



Regular Processing

A large enough sample that we can run our QA plots on it.

Need a large number of “ordinary” stars and galaxies to test the basics of the pipeline on.

Currently we run RCFakes which processes a tract using a default fakes catalogue, plans to expand this to more data.

Some edge/difficult cases in regular processing?

Irregular Processing

More obscure sources that would be useful for science users to prepare for real data but that don't need to be redone every two weeks.

For example:

High redshift objects, might only be present in one or two bands, need to test how multi band deblending and detection work on these dropouts.

Probably needs to be run once to understand and then occasionally to test major changes to these areas.

Currently semi-regularly running LSB galaxies to assess background subtraction effects.
(See Aaron Watkins talk later on)

What objects would be useful? Who has the skills to make them or their SEDs? What objects have surveys in the past struggled with?



Synthetic Source Injection Workshop

Recent DM source injection changes

Josh Meyers



Thurs, June 3, 2021

Adding API for injecting arbitrary [GalSim](#) profiles

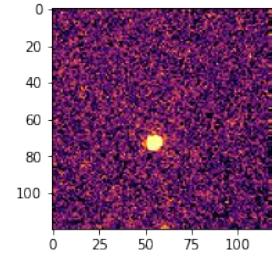
- Profiles automatically convolved with inferred PSF and transformed to local WCS.

```
import galsim
from lsst.pipe.tasks.insertFakes import _add_fake_sources
from lsst.geom import degrees, SpherePoint

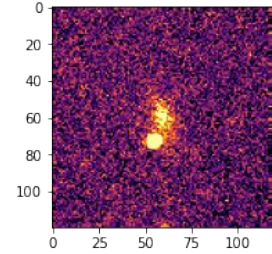
point = SpherePoint(
    336.4011301595296*degrees,
    1.4021462551407824*degrees
)
gsobj = galsim.RandomKnots(
    1000,
    profile=galsim.Exponential(flux=2e4, half_light_radius=1.0)
).shear(g1=0.3, g2=0.3)

# calexp = Butler.get(...)

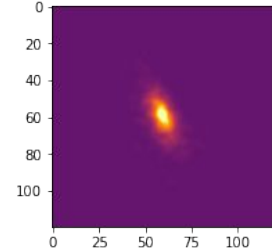
_add_fake_sources(calexp, [(point, gsobj)])
```



original



injected



difference

Housekeeping

- Bug fixes
- More consistent default column names for double Sersic catalog
- In the process of migrating source injection into its own Rubin science pipelines package.
- Details can be found at <https://jira.lsstcorp.org/browse/RFC-764>
- Look for an update to Sophie's community.lsst.org post sometime soon!