Proposal for Revised SN processing Structure

John Marriner
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SN Nightly processing pipeline

Overview of SN nightly processing pipelline

1. Run sextractor to determine zero point.
2. Run fakeSN to insert fake SN into reduced images.
3. Run SWARP to make nightly combined images.
4. Run sextractor to get catalog for PSF determination
5. Run psfex to get nightly PSF.
6. Run SWARP to make distorted templates
7. Run HOTPANTS to make difference image for nightly combined image
8. Run SEXTRACTOR to find objects on difference image for nightly combined image
9. Run SWARP to make distorted templates for individual exposures
10. Run HOTPANTS to make difference images for individual exposures
11. Run filterObj to select objects found on difference images
12. Run makeStamps to make miniature images of SN objects
13. Run SNmonitor and archive files

Each filter (band) is processed independently. The orchestration layer must determine which filters are present and begin processing after all the reduced frames are available for a given filter.

Standard difference imaging does not require a photometric solution.

In general there will be more than one exposure for each filter. Some processing is done with individual exposures and some is done with the co-addition of exposures (nightly combined images).

The directory structure and file names are not given in this document. Generally it is expected to be similar or identical to DC-4, but it could be modified as seems convenient.

This document gives the suffix names of files. The root will be take as “xxx” although the actual names used so far have included the camera pointing as follows: xxx=decam—25—42. The standard suffixes include “b” (band), “e” (exposure number), and “cc” (chip). “b” is a letter (g,r,I,z) “e” is a 2-digit number with leading zero suppressed and “cc” is a 2-digit number without suppressing the leading zero.

It is assumed that all programs produce a log file and a name is given for the log files. These files may be written directly (depending on the program) or output can be redirected to the appropriate named file or files may be copied or moved to the proper name.

Detail for step 1 (Run SEXTRACTOR to determine zero point)

Description

This run of sextractor is for the purpose of obtaining zero point information. The zero point is needed *only* to insert fake SN. The processing normalizes to the template zeropoint in hotpants.

This step is run on each individual exposure.

Input

a. reduced images = xxx-b-e_cc.fits (multi-header format)
b. sextractor options file = SNzero.sex
c. sextractor parameter file = SNzero.param
d. Command line = sex xxx-b-e_cc.fits –c SNzero.sex –PARAMETERS_NAME SNzero.params –CATALOG_NAME xxx-b-e_cc.cat –MAG_ZEROPOINT=25.0

Output

a. Catalog with positions and magnitudes (see command line for name)
b. Log file= xxx-b-e_cc_SNzero.log

Detail for step 2 (Run fakeSN to insert fake SN into reduced images)

Description:

Information on fake SN positions light curves is pre-computed and stored in the data base. This program reads reduced images and outputs the same image with simulated SN added to the image. A loop over reduced images is implied.

This program also takes the input files (in multi-header format) and creates output files in single header format. This latter functionality is needed even if the fakes are not added.

This step is run for each individual exposure.

Input

a. Database table of fake SN
b. Sextractor catalog from step 1 (name= xxx-b-e_cc_SNzero.cat)
c. Reduced frames (including weight maps)
d. Command line = fakeSN xxx-b-e_cc.fits

Output

a. SN reduced image, weight map, and mask files (names=xxx-b-e_cc_SN.fits, xxx-b-e_cc_SN.weight.fits, xxx-b-e_cc_SN.mask.fits)
b. Database table of fake SN (record observational data, a.k.a. "truth table")
c. Log file= xxx-b-e_cc _ fakeSN.log

Detail for step 3 (Run swarp to make nightly combined images)

Description

This program adds all the exposures in a given filter taken on the same night. The output images are known as the "nightly combined images"

We do not co-add mask files at this time, but may want to do so in the future. At present the outputs are an image file and a weight file.

Input

a. Reduced images and weight maps (names =xxx-b-ee_cc_SN.fits and xxx-b-ee_cc_SN.weight.fits).
b. File containing the paths to of all the reduced images for this night and band (name=xxx-b_cc.lis)
c. SWARP options file (name=nitecmb.swarp)
d. Header file corresponding to first image in the sequence (ie. the one with the smallest e). Name=xxx-b-e_cc_SN.head
e. Command line = swarp @xxx-b_cc.lis -c SNnitecmb.swarp -IMAGEOUT_NAME xxx-b_cc_nitecmb.fits -WEIGHTOUT_NAME xxx-b_cc_nitecmb.weight.fits

Output

a. Combined image and weight map (see command line for names).
b. Log file = xxx-b_cc_nitecmb.log

Detail for step 4 (Run sextractor to get catalog for PSF determination)

Description

The PSF is determined from the nightly combined image. In principle, we could determine the PSF separately for each reduced image, but it is expected that the psf from the nightly combined image will be adequate for the purposes of difference imaging.

Input

a. Nightly combined image and weight map (names =xxx-b-ee_cc_nitecmb.fits and xxx-b-ee_cc_nightcmb.weight.fits).
b. sextractor options file = SNpsfex.sex
c. sextractor parameter file = SNpsfex.param

d. Command line sex search.fits -c diffpsfex.sex -CATALOG_NAME xx-b_cc_nitecmb.cat -PARAMETERS_NAME SNpsfex.param

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Output

a. Catalog file (see command line)
b. Log file (name = xx-b_cc_psfex.log)

Detail for step 5 (Run psfex to get nightly PSF)

Description

The PSF is determined from the nightly combined image. In principle, we could determine the PSF separately for each reduced image, but it is expected that the psf from the nightly combined image will be adequate for the purposes of difference imaging.

Input

a. Nightly combined image (see command line for name)
b. Catalog file (see command line for name)
c. PSFEX options file = nitecmb.psfex
d. Command line: psfex xxx-b_cc_nitecmb.cat –c nitecmb.psfex -PSF_DIR TBD

Output

a. xxx-b_cc_nitecmb.psf
b. Log file –append to same log as step 4 (name=xxx-b_cc_psfex.log)

Detail for step 6 (Run swarp to make distorted image for nightly combined image)

Description

For the nightly combined image make a distorted template image.

Input

a. Nightly combined image header file (see command line for name)
b. Undistorted template file (see command line for name)
c. SWARP options file = SNdistemp.swarp

Command line= swarp xxx-b_cc.coadd.fits -c SNdistemp.swarp -IMAGEOUT_NAME xxx-b_cc.distmp.fits -WEIGHTOUT_NAME xxx-b_cc.distmp.weight.fits

Output

a. Distorted template file
b. Log file xxx-b-cc_distemp.swarp

Detail for step 7 (Run HOTPANTS to make difference image for nightly combined image)

Description
HOTPANTS is run on the nightly combined image and the corresponding distorted template.

Input

a. Nightly combine image, weight map (see command line for names)
b. Distorted template image and weight map (see command line for names).
c. Command line= hotpants -useWeight -nsx 10 -nsy 20 -c t -n t \

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-inim xxx-b_cc_nitecmb.fits \
-ini xxx-b_cc_nitecmb.weight.fits \
-il 5000 -iu 25000 \
-tmplim xxx-b_cc_ncdistmp.fits \
-tni xxx-b_cc_ncdistmp.weight.fits\
-tl -100 -tu 25000 \
-outim xxx-b_cc_nc.fits \
-oni xxx-b_cc_nc.weight.fits \
-omi xxx-b_cc_nc.mask.fits
```

The literal values in the command line will be based on a look-up table for each band. In the future it may be necessary to compute them from some information in the image, but it is not necessary to provide any features to support that at this time.

Output

a. Subtracted image file, weight map, and mask (see command line for names)
b. Log file (name=xxx-b_cc_hotpants.log)

Detail for step 8 (Run sextractor to find objects on difference image for nightly combined image)

Description
Sextractor is run on each of the difference images.

Input

a. Difference image and weight map
b. Sextractor options file = SNdiff.sex
c. Sextractor parameter file = SNdiff.param
d. Command line sex xxx-b_cc_nc.fits –c SNdiff.sex -WEIGHT_IMAGE xxx-b_cc_nc.weight.fits -PARAMETER-NAME SNdiff.param –CATALOG_NAME xxx-b_cc_nc.cat –MAG_ZEROPOINT=25.00

Output

a. Catalog file (see command line)
b. Log file (name=diffIm_SNdiff.log

Detail for step 9 (Run swarp to make distorted images for individual exposures)

Description

For each individual exposure make a distorted template image.

Input

a. Individual exposure image header file (see command line for name)
b. Undistorted template file (see command line for name)
c. SWARP default file = SNdistemp.swarp
d. Command line= swarp xxx-b_cc.coadd.fits -c SNdistemp.swarp -IMAGEOUT_NAME xxx-b-e_cc_distmp.fits -WEIGHTOUT_NAME xxx-b-e_cc_distmp.weight.fits

Output

a. Distorted template file
b. Log file xxx-b-cc_SNdistemp.swarp

Detail for step 10 (Run HOTPANTS to make difference images for individual exposures)

Description

HOTPANTS is run for each individual exposure.

Input

d. Individual exposures (w/ fakes) (see command line for names)
e. Distorted template image and weight map (see command line for names)

Command line= hotpants -useWeight -nsx 10 -nsy 20 -c t -n t \
-inim xxx-b-ee_cc_SN.fits \
-ini xxx-b-ee_cc_SN.weight.fits \
-il 5000 -iu 25000 \
-tmplim xxx-b-ee_cc_ncdistmp.fits \
-tni xxx-b-ee_cc_ncdistmp.weight.fits \
-tl -100 -tu 25000 \
-outim xxx-b-e_cc_nc.fits \
-oni xxx-b-e_cc_nc.weight.fits \
-omi xxx-b-e_cc_nc.mask.fits

The literal values in the command line will be based on a look-up table for each band. In the future it may be necessary to compute them from some information in the image, but it is not necessary to provide any features to support that at this time.

Output

a. Difference image, weight map, and mask (for names see command line)
b. Log file (name=xxx-b-ee_cc_hotpants.log)

Detail for step 11 (Run filterObj to select objects found on difference images)

Description

filterObj reads the output catalogs for all the search images for a given filter and selects objects to be stored in the data base..

Input

a. Nightly combined image and weight map
b. Sextractor catalog for nightly combined image (xxx.cat)
c. Individual exposure images and weight map
d. Command line

filterObj cat=xxx-b-e_cc_nitecmb.cat psf=xxx-b-e_cc.psf log=xxx-b-e_cc_filterObj.log comb=image_id images=xxx-b_cc.lis writedb=0

Output

a. Database entries
b. Log file (see command line)

Detail for step 12 (Run makeStamps to make miniature images of SN objects)

Description

Miniature (51x51 pixels) images (stamps) are generated for all objects in the data base for a given difference image. Stamps are generated in both gif and fits formats.

Input

a. Nightly combined search image
b. Command line:

makeStamps fimg=xxx-b_cc log=xxx-b_cc_makeStamps.log coadd=exposure_id fdir=output_directory

Output

a. Stamp images (names=yyy.fits and yyy.gif) yyy=SNimage_id_object_id?
b. Log file (name=xxx-b_cc_makeStamps.log)

Detail for step 13 (Run monitor and archive files)

Description
This step describes the diagnostic information that is collected and saved. It also describes the files that are archived. This step does not necessarily have to occur at the end of the pipeline, but can be integrated with each step as appropriate.

This describes the files that are to be archived from the difference imaging pipeline. The file archiving is described here as a separate step although it may (and probably will be integrated into the previous steps as appropriate).

Generally, for the purposes of archiving, images, weight maps, and mask files (if they exist) will be combined into a single multi-header file.

List of files

a. Image w/fakes as multi-header fits file
b. Distorted template as multi-header fits file
c. Difference image in as multi-header fits file
d. Log files and plots

SN Template Co-addition

Procedure overview

A. Run tNorm to prepare header files for swarp run
B. Run SWARP to make deep template

A subset of "good" images will be selected for making supernova templates. These images will be taken under photometric conditions as a minimum selection criterion, but may have additional requirements on seeing or other observing conditions.

It is anticipated that the creation of templates will be made infrequently (perhaps monthly early in the survey turning to annually at the end). This list of images in the coadd will probably be prepared manually and other preparation (collection of images into a common directory, for example) could also be accomplished manually.

Detail for step A (Run tNorm to prepare header files for swarp run)

Description

This program prepares all the necessary files for image co-additon by SWARP. The functions are:

1. To split multi-header files into single header images.
2. To obtain the zero point information for each image in the coadd.
3. To create the *.head files containing zero point information for each image in the coadd.

Input

a. Individual image files in multi-header format (image, mask, and weight)
b. List of input files (name=xxx-b_cc_SNtemp.lis)
c. Command line = tnorm @xxx-b_cc_SNtemp.lis

Output

a. Single header image and weight map files
b. *.head file for each image
c. Log file (name=xxx-b_cc_SNtNorm.log)

Detail for step B (Run SWARP to make deep template)

Description

This run of swarp is to make a template file in a standard TAN projection. It will be the input to creating distorted template files for the nightly processing.

Input

a. Individual image files in single header format (image and weight)
b. List of input files (name=xxx-b_cc_SNtemp.lis)
c. List of swarp options (name=SNtemp.swarp)
d. Command line = swarp @xxx-b_cc_SNtemp.lis –c SNtemp.swarp

Output

a. Template file and weight map (see command line)
b. Log file = xxx-b_cc_SNTemp.log

Detail for step 1 (Run tNorm to prepare header files for swarp run)

Description

This run of sextractor is for the purpose of obtaining zero point information. The zero point is needed *only* to insert fake SN. The real SN are normalized to the data in hotpants.

Input

e. nightly combined file
f. sextractor default file =
g. sextractor parameter file
h. Command line =

Output

c. Catalog with positions and magnitudes: name=xxx

SN Veto Catalog Creation

The SN Veto Catalog construction will be done infrequently. It can be done with SQL language and relatively simple scripts. The procedure is sketched, but details need to be filled in.

Overview of the procedure

1) Select rows from the object table in the SN fields that meet at least one of the following
   a) Looks like a star* and magnitude<18 (in any band)
   b) Magnitude<22 and varies by more than 1 magnitude

2) Ingest selected rows into SNVeto table columns as appropriate.

*(class_star_i > 0.85 --> star; class_star_i <= 0.85 --> galaxy)