How to write catalogs that SCAMP can read

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1 Intro

Scamp deals with two kinds of catalogs:

catalog: a list of sources in your image

reference catalog: a list of refence sources from USNO-B1 or other astrometric reference catalog

Their structures are mostly the same: they are in `FITS-LDAC` format, which was created for the DENIS survey and implemented in the `ldactools` package, which is still available but has been unmaintained since 1998.[1]

The overall format is:

primary header: just the usual minimal header cards

first extension: an `EXTNAME = LDAC_IMHEAD` extension, which is a BINTABLE containing the FITS header cards of the original image.

second extension: an `EXTNAME = LDAC_OBJECTS` extension, which is a BINTABLE containing the list of sources.

You could probably put the extensions in a different order, since I think they're only referred to by name.

2 LDAC_IMHEAD header

Here is a sample `LDAC_IMHEAD` header:

```
XTENSION= 'BINTABLE' / FITS Binary Table Extension
BITPIX  =                    8 / 8-bits character format
NAXIS   =                    2 / Tables are 2-D char. array
NAXIS1  =                13200 / Bytes in row
NAXIS2  =                    1 / no comment
PCOUNT  =                    0 / Parameter count always 0
GCOUNT  =                    1 / Group count always 1
TFIELDS =                    1 / No. of col in table
TFORM1  = '13200A  ' / Format of field
TTYPE1  = 'Field Header Card' / Field label
TUNIT1  =                      / Physical unit of field
ORIGIN  = 'ESO-QFITS' / Written by QFITS
DATE    = '2008-07-18T16:53:22' / [UTC] Date of writing
```

[1] ftp://ftp.iap.fr/pub/from_users/bertin/ldactools/ldactools_1.2.tar.gz – note that this code also includes the bug mentioned here: http://terapix.iap.fr/forum/showthread.php?tid=365

```
TDIM1   = '(80, 165)' / shape of header: FITS cards
EXTNAME = 'LDAC_IMHEAD' / no comment
END
```

As you can see, it is a table with one column and one row, where the column is a text array big enough to hold all the FITS header cards of the original image, without padding it out to the 36-card FITS block size.

You **must** name the first column `Field Header Card`.

The extension **must** be called `LDAC_IMHEAD`.

I don't know if you need to set the `TDIM1` card, but it's probably not a bad idea.

3 LDAC_IMHEAD body

The data chunk of this extension is simply the FITS header cards from the original image.

For catalogs, these header cards **must** include a WCS solution. Also, `NAXIS1` and `NAXIS2` determine the range of source object coordinates that will be accepted, so they should be set to the width and height of the original image.

You should probably pad the file out to the FITS block size (2880) using space characters rather than zeros, because then it can be parsed by the normal FITS tools.

4 LDAC_OBJECTS header

Nothing too fussy here, it just has to have `EXTNAME = LDAC_OBJECTS`.

5 LDAC_OBJECTS body

5.1 Catalogs

Catalogs need at least the following columns. Some of the column names can be changed in the Scamp configuration file.

`XWIN_IMAGE`, `YWIN_IMAGE` [pixels] location of the source. Settable with the `CENTROID_KEYS` config-file keyword; you'll probably also want to change `DISTORT_KEYS` to match.

`ERRAWIN_IMAGE`, `ERRBWIN_IMAGE`, `ERRTHETAWIN_IMAGE` [pixels, pixels, degrees] supposedly, the error ellipse of the source position: major axis radius, minor axis radius, and angle between the major axis and the `NAXIS1` axis; the SourceExtractor documentation (section 9.1.5) says it's measured "counter-clockwise", whatever that means.[2] These column names can be changed by the `CENTROIDERR_KEYS` config option. In reality, Scamp ignores `ERRTHETAWIN_IMAGE` completely and sets the error to be $\sqrt{A^2 + B^2}$.[3]

`FLUX_AUTO`, `FLUXERR_AUTO` – Scamp uses the flux signal-to-noise ratio while finding the astrometry of your catalog. You can change the name of these columns with the `PHOTFLUX_KEY` and `PHOTFLUXERR_KEY` config options.

5.2 Reference Catalogs

Reference catalogs need the following.

`X_WORLD`, `Y_WORLD` [degrees] are the (RA, Dec) positions of the reference sources. Settable with `ASTREFCENT_KEYS` keyword.

[2] FITS does not define how an image should be displayed so "clockwise" has no meaning.

[3] Scamp 1.4.6: `samples.c` line 398.

`ERRA_WORLD`, `ERRB_WORLD` [degrees, degrees] supposedly the major and minor axes of the error ellipse of the reference sources; Scamp actually just sets the error to $\sqrt{A^2 + B^2}$.[4] Settable with config option `ASTREFERR_KEYS`.

`MAG` [mag] magnitudes of sources.

6 Scamp configuration file

In order to make Scamp read your reference catalog, you need to set the config option `ASTREF_CATALOG` to `FILE`, and `ASTREFCAT_NAME` to the reference catalog filename.

[4] Scamp 1.4.6: `astrefcat.c` line 1179.