Dark Energy Data Management System: Overview and Challenges

Shantanu Desai
NCSA and UIUC, Astronomy Computational Astrostatistics Workshop
Dark Energy Survey

DES is $5000^2$ degree grizY Imaging survey of Southern hemisphere to map out dark energy equation of state.

CTIO Blanco 4m telescope. Replace PF cage with 2.2 deg. FOV 570 Mpixel Camera.

525 nights from Oct 11- Feb 16

(1 TB of compressed data per night)
DESDM goals

- Process DECam data from DES survey (4 PB of data, 350 TB of database)
- Provide a pipeline to NOAO to process DECam data for non-DES observers.

DESDM as of now

- Process and analysis of simulated DES data (as part of yearly data challenges since Fall 2005).
  (~6000 CPU hrs for 1 simulated night)

- Process real data from current CTIO 4 m telescope (Blanco Cosmology Survey and more recent data for optical follow-ups of clusters detected by South Pole telescope.)
Pipeline Overview

• Basic detrending (crosstalk correction, instrumental signatures)
• Astrometric Calibration (SCAMP)
• Masking (cosmic rays, bright stars, satellite trails)
• Cataloging/Model-fitting (Sextractor)
• Remapping of images to perfect tangent plane (SWARP)
• Global Photometric Calibration.
• Coaddition pipeline
  ➢ PSF Homogenization (PSFEX)
  ➢ Image Coaddition (SWARP)
  ➢ Cataloging/model-fitting of Coadd Images.
Nightly Processing
Data Flow
DES Science Requirements

- Limiting magnitudes of 24.6, 24.1, 24.3, 23.8, 21.5 in grizY respectively in 1.5'' apertures with >=97.5 % completeness and 95 % purity.

- Position Accuracy ~ 100 milli-". Photometric Calibration : 2 "

Results with simulated DES data
Cataloging/Model-Fitting

- Use Sextractor (E. Bertin)

Improved Star-Galaxy separation

Improved Background noise Modelling and subtraction.

Better PSF modelling

Deblending
Bright Star Masking

Location and size of circle from USNOB catalog and using an empirical fit

Grid around circle used to calculate Median and Sigma.

Replace the pixel values in the circle with Gaussian noise with mean and sigma that of a square grid around the circle
Masked Image
Cosmic-Ray Masking

- Use the *eye* program to create a retina file to model the cosmic rays defects (use RPROP neural-network algorithm) by supplying a file with and without cosmic rays. Run *SExtractor* using this retina file to produce a cosmic ray only image.
Image with Cosmic Rays

Example of Remap Image with cosmic rays

Cosmic Ray
Image without Cosmic rays

Example of Remap image with cosmic rays masked
Faint stars masqueraded as cosmic rays due to very low Sextractor thresholds. Looking for alternate cosmic ray masking algorithms.
Conclusions and Future Plans

• Stress test with larger size of simulated DES data (this Spring)
• Analysis and release of data from BCS.
• Also will analyze data from other surveys/telescopes (CFHT, Subaru, Pan-Starrs)

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See [http://www.usm.lmu.de/~shantanu/schedule.html](http://www.usm.lmu.de/~shantanu/schedule.html)