CosmoStat WL Pipeline

Samuel Farrens

Outline

1. Pipeline Motivation
2. Pipeline Team
3. Pipeline Architecture
4. Pipeline Development

CosmoStat + EPFL

GREAT3
The third GRavitational lEnsing Accuracy Testing challenge

Overall Leaderboard

Name	Notes	Score	Number of entries
sFIT	Modified DLS stackfit algorithm	80001	162
Amalgam@IAP	Some fellows developing software based around SExtractor and PSFex for real-life shape measurements.	80000	215
CEA-EPFL	The team wants to investigate if we could improve shear estimation by combining gfit with sparse representation methods.	72000	340
MegaLUT	Evolutions of the MegaLUT technique : how far can we go with SExtractor + Machine Learning ?	52000	234
Fourier_Quad	Our team uses the quadrupole moments of the spectral density of galaxy images in Fourier space to measure shear.	32000	36
EPFL_gfit	Using the gfit shear measurement method, testing how far one can go by using forward model fitting + new approaches for bias calibration	24000	124
MaltaOx	Malta-Oxford GREAT3 team. We aim to test shear measurement by likelihood fits to individual galaxies, using lensfit, and without using simulations to calibrate bias.	3001	15
E-HOLICs	E-HOLICs method is developed for aim of precise and fast shear analysis. E-HOLICs method is moment method like KSB method , but use elliptical weight function for avoiding one of systematic errors.	3000	58
MBI	Team members:Lang CMU, Hogg NYU, Schneider LLNL, Dawson LLNL, Bard SLAC, Marshall SLAC, Meyers Stanford, Boutigny SLAC	1000	51
COGS	Capitalizing On Gravitational Shear Team based primarily at University of Manchester and University College London, and lead by Sarah Bridle. Most entries will use the im3shape code described in http://arxiv.org/abs/1302.0183.	*	38
GREAT3_EC	GREAT3 executive committee - submissions using example scripts.	*	10
EPFL_lensfit	Testing a multi-processor version of lensfit 7.2 (Miller et al., 2007, Kitching et al., 2008)	0	0
FDNT	Fourier Domain Null Test method (Bernstein 2010) with additional m+c bias calibration	*	36
ess	Various pipelines by Erin S. Sheldon	0	13
DeepZot	Team members: Daniel Margala and David Kirkby at UC Irvine	0	0
CMU experimenters	This is a team for Rachel Mandelbaum's group at CMU to experiment with some crazy ideas that probably won't work, but are kind of fun to think about.	*	4
miyatake-test	Test for GREAT3 data by the HSC pipeline.	*	4
CEA_denoise	Moment correction on denoised images.	0	25
MetaCalibration	This team is testing how well we can extract the shear response by shearing the images themselves, and modifying the psf accordingly.	*	3
BAMPenn	Bernstein, Armstrong & March, University of Pennsylvania.	0	8
HSC/LSST-HSM	A sanity check of the bookkeeping in the obs_great3 package written to allow HSC/LSST pipeline algorithms to be run on the GREAT3 simulations, using an old implementation of the HSM code.	*	4
EPFL_MLP_FIT	multilayer perceptron, fitted data as input	0	1
EPFL_KSB	From quadrupole moments to shear, based on the KSBf90 (Heyamans et al. 2005).	0	39
EPFL_HNN	Hopfield Neural Network	0	32
EPFL_MLP	MLP	0	51
Wentao Luo	A modified method based on both BJ02(Bernstein & Jarvis 2002) and HS03(Hirata & Seljak 2003).	0	25

Pipeline Motivation

Modular implementation →

- Ability to add new features with minimal impact on the global architecture

Python Job-Handler →

- Fast development
- Good portability (e.g. no PBS system requirements, etc.)

End-to-End Processing →

- In-house analysis
- Minimise dependence on outside processing

Pipeline Team

Development & analysis

Samuel Farrens	pipeline management, development
Axel Guinot	pipeline development, processing
Martin Kilbinger	pipeline development, processing
Arnau Pujol	bias estimation, validation tests
Morgan Schmitz	PSF estimation

Methodology & analysis

Jerome Bobin	machine learning, shear calibration
Alexandre Bruckert	blend identification
Austin Peel	mass mapping
Sandrine Pires	mass mapping
Jean-Luc Starck	weak lensing science
Florent Sureau	shape measurement

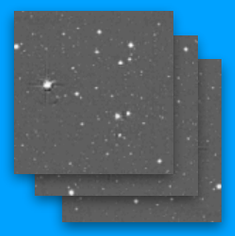
Pipeline Architecture

Core Pipeline

- Single Python package
- Job handler for parallel processing of images
- Centralised IO system
- Versioning control
- Configuration file management
- Logging system for error handling
- External executable control

Pipeline Architecture

Input Images



Mask Generation

- Bright stars
- Spikes
- Haloes
- (Cosmic Rays)

Source Extraction

- SExtractor

Star-Galaxy Separation

- FWHM vs Magnitude cut

PSF Modelling

- PSFEx
- Vignettes from PSF model

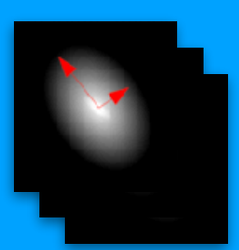
Shape Measurement

- KSB
- GFit

Calibration

- Meta-calibration

WL Catalogue



Cosmological Analysis

- Mass mapping
- Shear bias

Pipeline Architecture

List of Old Packages

- **PSFExInterpolation_package**
- **PSFExRun_package**
- **SETools_package**
- **SExtractor_package**
- gfit_common_package
- gfit_package
- isap_package
- **mask_package**
- mkpsf_package
- mksim_package
- mpfcfhtlens_package
- mpfcs82_package
- mpfg3_package
- **mpfg_package**
- **mpfx_package**
- multifit_package
- **ngmix_wrapper_package**
- *ppe_package* --> replaced by **PSFExRun_package**
- *pse_package* --> replaced by **SExtractor_package**
- **scatalog_package**
- scdm_package
- **sconfig_package**
- sf_deconvolve_package
- **shapelens_package**
- **slogger_package**
- spredict-0.5.0
- template_package

Pipeline Architecture

List of New Modules

- args
- config
- execute
- file_handler
- fileIO
- job_handler
- run_log
- timeout
- worker_handler

- mask_runner
- metacal_runner
- psfex_runner
- psfexinterp_runner
- setools_runner
- sextractor_runner
- vignetmaker_runner

Pipeline Development

- Private GitLab repository hosted on CEA server
  - Integrated wiki
- Well-defined development plan
  - Issue definition (with tracking)
  - Milestone for set of issues
  - User branches for specific issues
  - Merge request review
  - Documentation
- Validation test framework
- Continuous integration tests

Pipeline Development

Core Pipeline

- Impr
- Impr ed l
- Simplifi ilation

Deblending

- DNN blend identification
- Multi-class labelling
- Segmentation

PSF Modelling

- RCA
- Optimal transport
- Graphs

Mask Generation

- Extended artefact handling
- Machine learning

Deconvolution

- Sparsity
- Low-rank approximation
- Tikhonov + DNN

Thank You