The CFIS Pipeline

Samuel Farrens
Outline

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

Overall Leaderboard

<table>
<thead>
<tr>
<th>Name</th>
<th>Notes</th>
<th>Score</th>
<th>Number of entries</th>
</tr>
</thead>
<tbody>
<tr>
<td>eFIT</td>
<td>Modified DLS stackfit algorithm</td>
<td>80000</td>
<td>340</td>
</tr>
<tr>
<td>AmiDap@IPAP</td>
<td>Some fellows developing software around SEXtractor and PSFex for real-life shape measurements.</td>
<td>80000</td>
<td>215</td>
</tr>
<tr>
<td>CEA-EPFL</td>
<td>The team wants to investigate if we could improve shear estimation by combining gift with sparse representation methods.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MegaULT</td>
<td>Evolutions of the MegulT technique: how far can we go with Sextractor + Machine Learning?</td>
<td>72000</td>
<td></td>
</tr>
<tr>
<td>Fourier_Quad</td>
<td>Our team uses the quadrupole moments of the spectral density of galaxy images in Fourier space to measure shear.</td>
<td>52000</td>
<td></td>
</tr>
<tr>
<td>EPFL_gif</td>
<td>Using the gift shear measurement method, testing how far one can go by using forward model fitting + new approaches for bias calibration.</td>
<td>32000</td>
<td>124</td>
</tr>
<tr>
<td>MaltaOn</td>
<td>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.</td>
<td>24000</td>
<td></td>
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<tr>
<td>E-HOLICs</td>
<td>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.</td>
<td>3000</td>
<td>15</td>
</tr>
<tr>
<td>MBJ</td>
<td>Team members: Lang CMU, Hogg NYU, Schneider LLNL, Dawson LLNL, Bard SLAC, Marshall SLAC, Meyers Stanford, Boutigny SLAC</td>
<td></td>
<td>1000</td>
</tr>
<tr>
<td>COGS</td>
<td>Capitalizing on gravitational shear team based primarily at University of Manchester and University College London, and led by Sarah Bridle. Most entries will use the im3shape code described in <a href="http://arxiv.org/abs/1302.0183">http://arxiv.org/abs/1302.0183</a>.</td>
<td>3000</td>
<td>58</td>
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<tr>
<td>GREATE3_EC</td>
<td>GREATE3 executive committee - submissions using example scripts.</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>EPFL_jana</td>
<td>Testing a multi-processor version of lensfit 7.2 (Miller et al., 2007, Kitching et al., 2008)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>FDOT</td>
<td>Fourier Domain Null Test method (Bernstein 2010) with additional mrc bias calibration</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>rgs</td>
<td>Various pipelines by Erin S. Sheldon</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>DeepZot</td>
<td>Team members: Daniel Margala and David Kirkby at UC Irvine</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>CMU experimenters</td>
<td>This is a team for Rachel Mandelbaum's group at CMU to experiment with some crazy ideas that probably won't work, but also kind of fun to think about.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>mFishack-test</td>
<td>Test for GREATE3 data by the HSC pipeline.</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>GLEA_data</td>
<td>Moment correction on denoised images</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>MegalCalibration</td>
<td>This team is testing how well we can extract the shear response by shearing the images themselves, and modifying the pdf accordingly.</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>BAMPlan</td>
<td>Bernstein, Armstrong &amp; March, University of Pennsylvania.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>HSCULSST-HSM</td>
<td>A sanity check of the bookkeeping in the obs_great3 package written to allow HSCULSST pipeline algorithms to be run on the GREATE3 simulations, using an old implementation of the HSM code.</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>EPFL_MLP_FIT</td>
<td>Multilayer perceptron, fitted data as input</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>EPFL_KSB</td>
<td>From quadrupole moments to shear, based on the KSB90 (Heymans et al. 2005).</td>
<td>0</td>
<td>39</td>
</tr>
<tr>
<td>EPFL_HNN</td>
<td>Hopfield Neural Network</td>
<td>0</td>
<td>32</td>
</tr>
<tr>
<td>EPFL_MLP</td>
<td>MLP</td>
<td>0</td>
<td>51</td>
</tr>
<tr>
<td>Weizhao Luo</td>
<td>A modified method based on both BJ02(Bernstein &amp; Jarvis 2002) and HS03(Hrata &amp; Sejak 2003).</td>
<td>0</td>
<td>25</td>
</tr>
</tbody>
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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

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Samuel Farrens</td>
<td>pipeline management, development</td>
</tr>
<tr>
<td>Axel Guinot</td>
<td>pipeline development, processing</td>
</tr>
<tr>
<td>Martin Kilbinger</td>
<td>pipeline development, processing</td>
</tr>
<tr>
<td>Arnau Pujol</td>
<td>bias estimation, validation tests</td>
</tr>
<tr>
<td>Morgan Schmitz</td>
<td>PSF estimation</td>
</tr>
<tr>
<td>Jerome Bobin</td>
<td>machine learning, shear calibration</td>
</tr>
<tr>
<td>Alexandre Bruckert</td>
<td>blend identification</td>
</tr>
<tr>
<td>Austin Peel</td>
<td>mass mapping</td>
</tr>
<tr>
<td>Sandrine Pires</td>
<td>mass mapping</td>
</tr>
<tr>
<td>Jean-Luc Starck</td>
<td>weak lensing science</td>
</tr>
<tr>
<td>Florent Sureau</td>
<td>shape measurement</td>
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</tbody>
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**Development & analysis**

**Methodology & analysis**
Pipeline Architecture

Core Pipeline

- Series of Python packages
- Job handler for parallel processing of images
- Centralised IO system
- Versioning control
- Configuration file management
- Logging system for error handling
The CFIS Pipeline

### Pipeline Architecture

#### Input Images

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

#### Mask Generation

- SExtractor

#### Source Extraction

- FWHM vs Magnitude cut

#### PSF Modelling

- PSFEx
- Vignettes from PSF model

#### Star-Galaxy Separation

- Mass mapping
- Shear bias

#### Shape Measurement

- KSB
- GFit

#### Calibration

- Meta-calibration

#### WL Catalogue
Pipeline Architecture

Relevant Talks

Overview of CFIS Weak Lensing

Martin Kilbinger
Pipeline Architecture

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

Source Extraction
- SExtractor

Shape Measurement
- KSB
- GFit

Star-Galaxy Separation
- FWHM vs Magnitude cut

PSF Modelling
- PSFEx
- Vignettes from PSF model

Calibration
- Meta-calibration

Cosmological Analysis
- Mass mapping
- Shear bias

WL Catalogue
Pipeline Architecture

Relevant Talks

**PSF Modelling**
- PSFEx
- Vignettes from PSF model

*PSF Modeling using a Graph Manifold*
Morgan Schmitz

**PSF Modelling**
- PSFEx
- Vignettes from PSF model

*Optimal Transport and PSF Modeling*
Rebeca Araripe Furtado Cunha
Pipeline Architecture

Input Images

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

Source Extraction
- SExtractor

PSF Modelling
- PSFEx
- Vignettes from PSF model

Star-Galaxy Separation
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Shape Measurement
- KSB
- GFit

Calibration
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WL Catalogue

Cosmological Analysis
- Mass mapping
- Shear bias

ShapePipe overview
Presentation of ShapePipe and its first use on CFIS data, preliminary results on the W3 field

UNIONS CFIS/Pan-STARRS Collaboration Meeting 6-8 juin 2018
Guinot Axel
Pipeline Architecture

Relevant Talks

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

Source Extraction
- SExtractor

Star-Galaxy Separation
- FWHM vs Magnitude cut

Preliminary CFIS Results
Axel Guinot

Shape Measurement
- KSB
- GFit

Calibration
- Meta-calibration
The CFIS Pipeline

Pipeline Architecture

Input Images
- Mask Generation
  - Bright stars
  - Spikes
  - Haloes
  - (Cosmic Rays)
- Source Extraction
  - SExtractor

Shape Measurement
- KSB
- GFit

Calibration
- Meta-calibration

PSF Modelling
- PSFEx
- Vignettes from PSF model

Star-Galaxy Separation
- FWHM vs Magnitude cut

WL Catalogue

Cosmological Analysis
- Mass mapping
- Shear bias
Pipeline Architecture

Relevant Talks

Cosmological Analysis
- Mass mapping
- Shear bias

WL Mass Mapping
Jean-Luc Starck

Cosmology with Mass Maps
Austin Peel
Pipeline Architecture

List of Modules

- PSFExInterpolation_package
- PSFExRun_package
- SETools_package
- SExtractor_package
  - gfit_common_package
  - gfit_package
  - isap_package
- mask_package
- mkpsf_package
- mksim_package
- mpfcfhtlens_package
- mpfcgs82_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 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 issue
  - Merge request review
  - Documentation

- Validation test framework
Pipeline Development

**Core Pipeline**
- Improved IO
- Improved logging
- Simplified installation

**Deblending**
- DNN blend identification
- Multi-class labelling
- Segmentation

**Deconvolution**
- Sparsity
- Low-rank approximation
- Tikhonov + DNN

**PSF Modelling**
- RCA
- Optimal transport
- Graphs

**Mask Generation**
- Extended artefact handling
- Machine learning
Pipeline Development

Deblending
- DNN blend identification
- Multi-class labelling
- Segmentation

Machine learning for blended objects separation
Alexandre Bruckert
谢谢