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# Early astrometric residuals characterization of LSSTCam: Atmospheric turbulences and static sensor effect.

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ABSTRACT

Using on sky data from 2025 from LSSTCam, an analysis of astrometric residuals output is done. As expected, Astrometric residuals are dominated by atmospheric turbulences. Once the contribution of the turbulence is removed by modeling it with anisotropic Gaussian process, effect at the sensor level is compute to characterize static astrometric defect.

## 1. INTRODUCTION

**Put your paper here.**

This is the Rubin Observatory overview paper: Ivezić et al. (2019).

- Explain Astrometry.
- Requirment for Rubin.
- Important for Lensing, solar system physics.
- DES observed E-mode and static component.
- Similar result were observed in HSC.
- Early result of LSSTComCam are showing this to.
- Goal here is to characterize for Rubin to see how perform the global astrometric solution.
- See how Turbulence is behaving on Rubin with shorter exposure time and see any static effect.

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- Use data from DP2 to assess this from LSSTCam took in the first few month of the camera beeing on sky.

## 2. ASTROMETRIC SOLUTION AND RESIDUALS FROM LSSTCAM

### 2.1. *Astrometric solution from LSSTCam*

- Rubin software is used to process the image.
- Astrometry is compute using a modified version of DES Astrometry.
- Solution is compute using all visit from a given tract.
- Match between detected source and Gaia.
- A polynomial for fov and a polynomial per detector.
- fit proper motion.
- Residuals are compute to be the diff between mean object position and position in current visit.
- We look at residual in Focal plane coordinate system.
- x and y are position into focal plane and dx and dy astrometric residuals.

### 2.2. *Characterization of Astrometric residuals of LSSTCam*

- Show residuals in some visit at different time.
- Show E/B mode distribution.
- Show that some visit exibit B-mode.
- Compare with PSF ?
- E mode vs time ?
- Discuss that way stronger than DES, and HSC. Make a comment compared to DP1.

## 3. GAUSSIAN PROCESS MODELING OF ASTROMETRIC RESIDUALS AT SINGLE VISIT LEVEL

### 3.1. *The GP model*

- This is exactly the same thing as in HSC
- Just remind quickly
- Explain what is different with DES again
- Say O(n * log(n))

### 3.2. *Practical implementation for Rubin*

- Randomly select 10k source.
- Interpolate CCD per CCD using the full focal plane kernel.
- Does not look to affect performance.

### 3.3. *Results*

- Show some visit result.
- Explain that with dense field looks GP, still some remaining stuff.
- Final correlation.
- Make same plot than DES to have side to side comparaison?

## 4. STATIC ASTROMETRIC DISTORTION

### 4.1. *Full Focal plane vue*

- Show full FoV distorsion
- Show some CCD with some filtering
- Show what happened when closing the loop

### 4.2. *On ITL distortion*

- Average plot and comment it looks like SLAC measurement.

### 4.3. *On E2V distorsion*

- Average plot and comment not fully understood as I am writting those line but looks like the SLAC measurment to.

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*Facility:* Rubin

*Software:* LSST Science Pipelines

## REFERENCES

Ivezić, Ž., Kahn, S. M., Tyson, J. A., et al. 2019, ApJ, 873, 111, doi: 10.3847/1538-4357/ab042c