Impact of filtering on Cygno’s images

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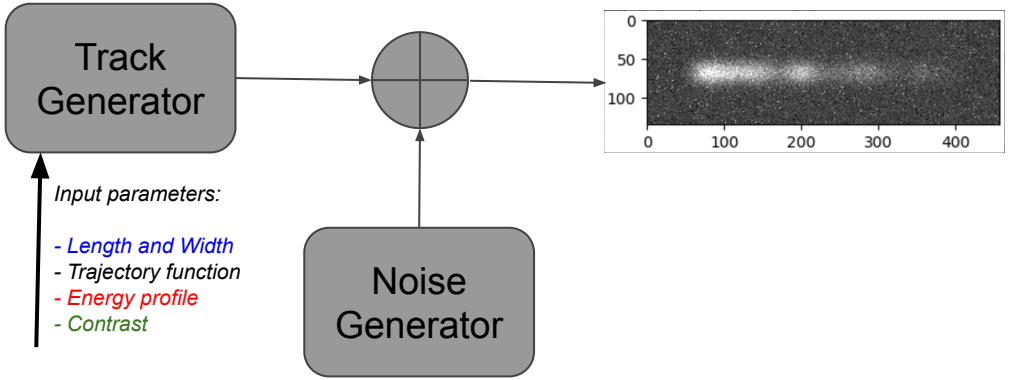
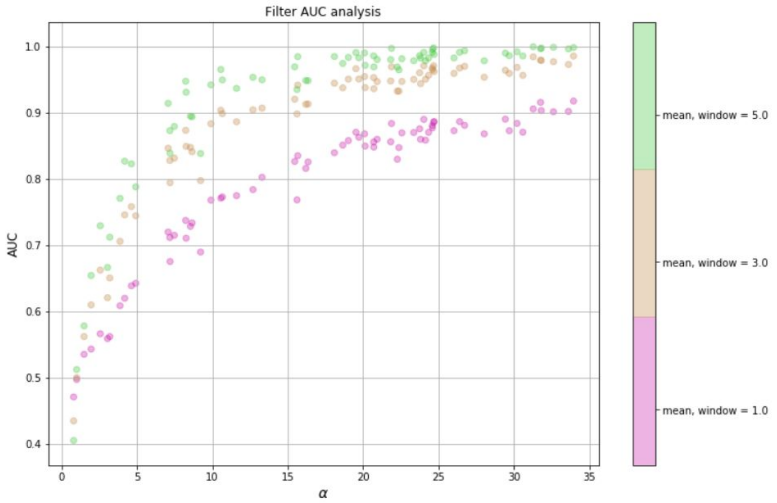
Historical Overview

- Since the beginning of this work the need of a simulation tool was present (one year ago)
- Therefore, before thinking about filtering we worked on a simulation tool that would generate signal + noise, all based on the real Cygno's images:
  - The real physical signal itself was hard to simulate without using GARFIELD/GEANT packets, then we proposed a simple method that seemed to work **for the purpose of testing the filters.**
  - The noise process was simulated based on analysis made with real noise acquisition runs:
    - This noise simulation was though in a way that it could be integrated to any new signal simulation tool that could come up in the future.
- With this tool in hands we could implement and test the first filters for Cygno;
- Recently, a new simulation tool (from Roma) was available and then we believe that we can converge with the filtering studies:
  - AND publish a paper about the impact of them to the Cygno's images.

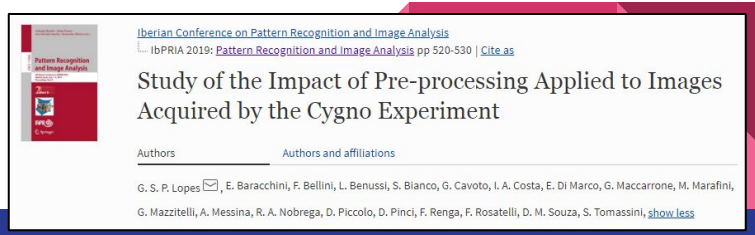
Simulation with the UFJF simulation setup



...and sweeping contrast (α) we could generate this kind of result



so we had preliminar indications that the detection efficiency of the pixels that are part of the tracking could be improved...



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Study of the Impact of Pre-processing Applied to Images Acquired by the Cygno Experiment

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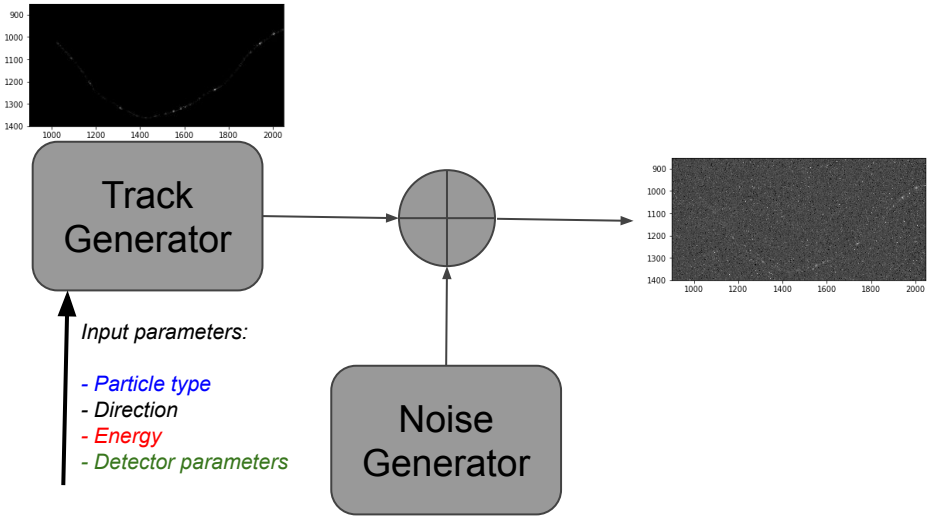
New --> Tracks (by Roma) + Noise (by UFJF)

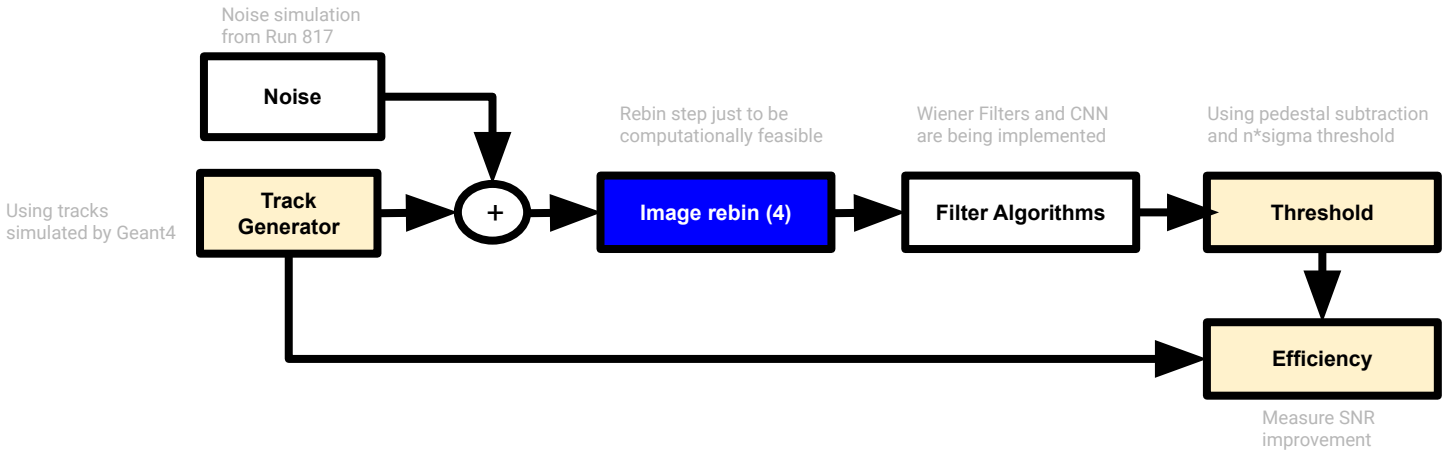


With this new setup we believe we could go for a JINST paper…

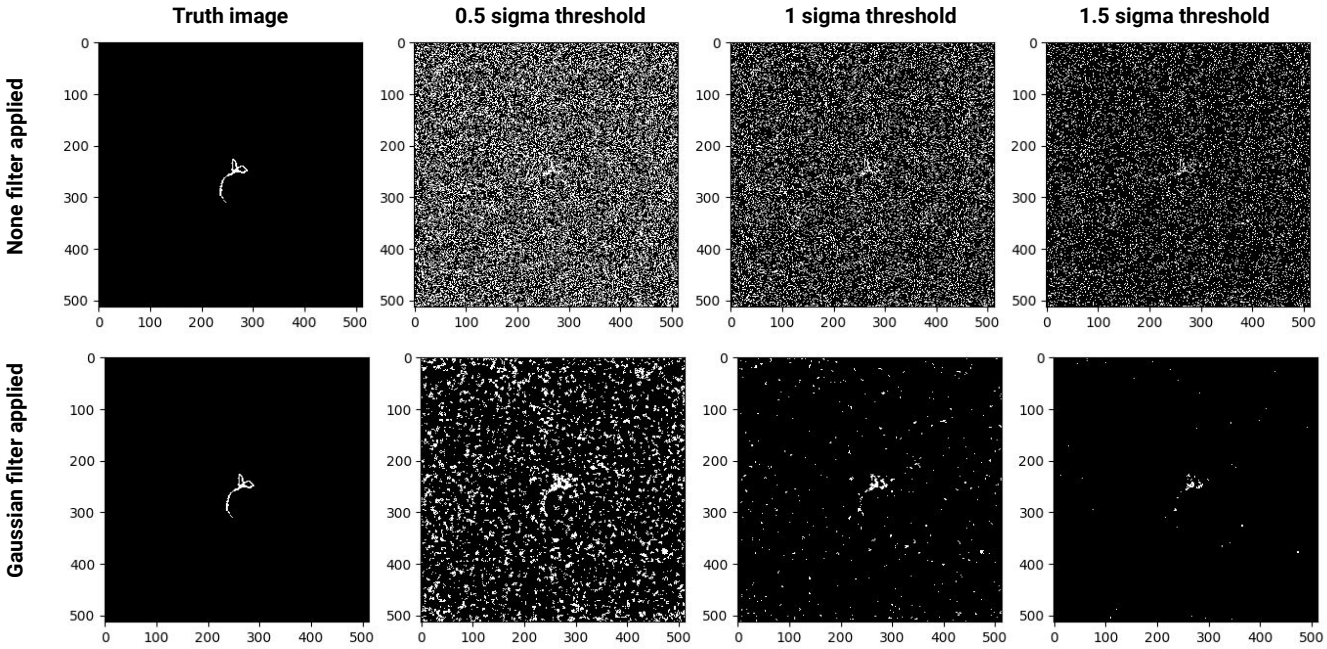
Subject: Impact of filtering to the Cygno's Images

- *We would like to come up with, at least, one sophisticated filter to justify better a publication*
- *And we need to have simulated particles that has a meaning for the experiment.*

Some adjusts on our simulation environment

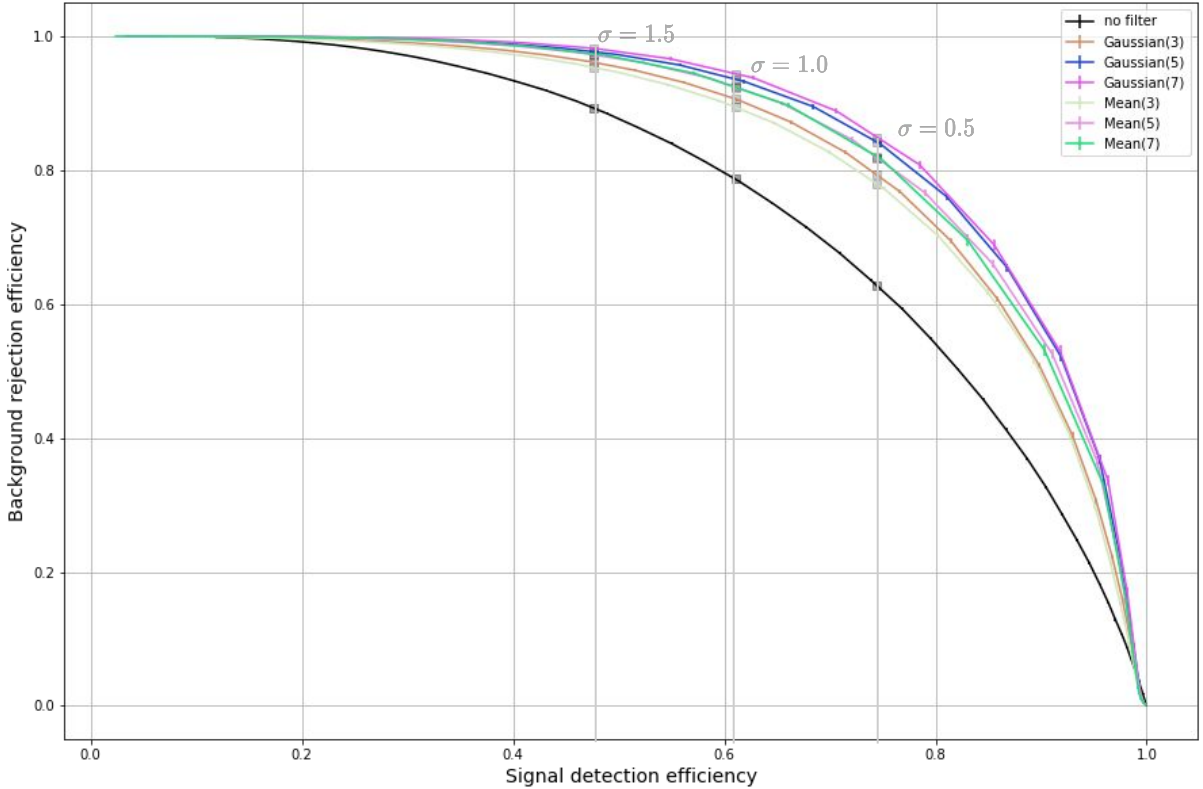


An example of 100 keV electron



Example using Gaussian Filter

Preliminary results



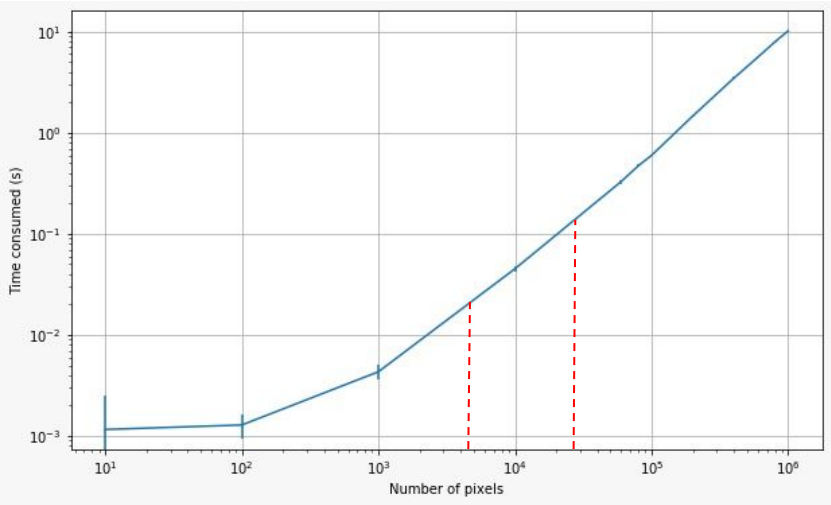
For the images without filter we fixed the signal detection efficiency for a few n*sigma thresholds:

- A background rejection improvement could be noticed by using filtered images;
- That gain should improve dbscan performing time;

Preliminary results

Number of background pixels

	$n\sigma$		
Filter	**0.5**	**1**	**1.5**
None	97390	55719	27956
Mean (3)	57669	27673	12135
Gauss (3)	54194	24416	10134
Mean (5)	47426	19799	7243
Gauss (5)	41300	16734	6044
Mean (7)	46946	19875	6865
Gauss (7)	**39421**	**14595**	**4696**

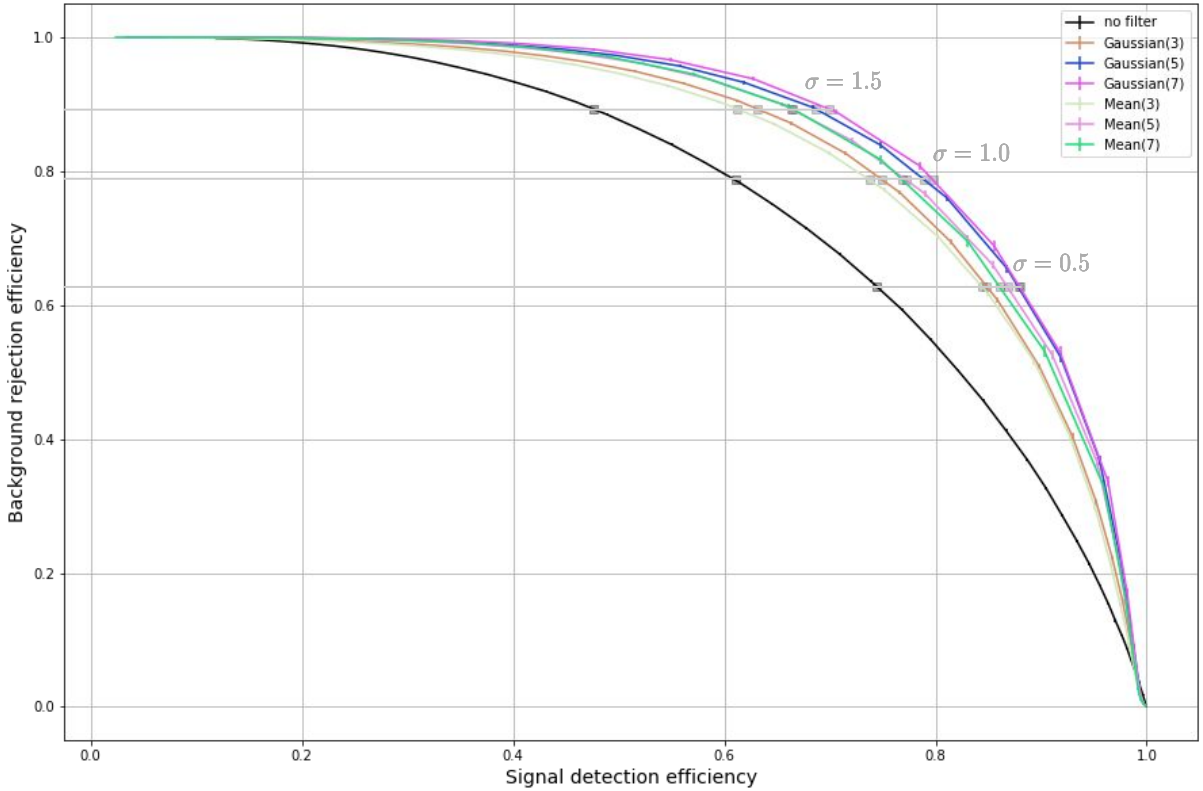


It's also important to remember that the dbscan is working using a 'simulated' 3D dimension that can increase the number of pixels by a factor ~10 in some cases.

Filtering images, the number of background pixels is reduced and consequently dbscan's time running.

83% of reduction at 1.5 sigma

Preliminary results



Otherwise, we can fix background rejection and perform the signal detection efficiency:

- *This approach can show us an energy estimation improvement;*
- *For the same background rejection, using filters, we get a signal detection efficiency gain.*

Proposal: Filtering paper publication

What we would like to do for this publication in few lines:

- prove that it is possible to reduce the noise keeping the efficiency (SNR improvement);
- reducing the number of fake signals due to electronic noise (in a year for example);
- study the filters' impact on the energy estimation.

Those things are easier to do with the simulated dataset. But, in a last section we would like to use real data (still thinking which parameters could be measured to show the filtering working).