CMOS Noise Simulation

Proposal

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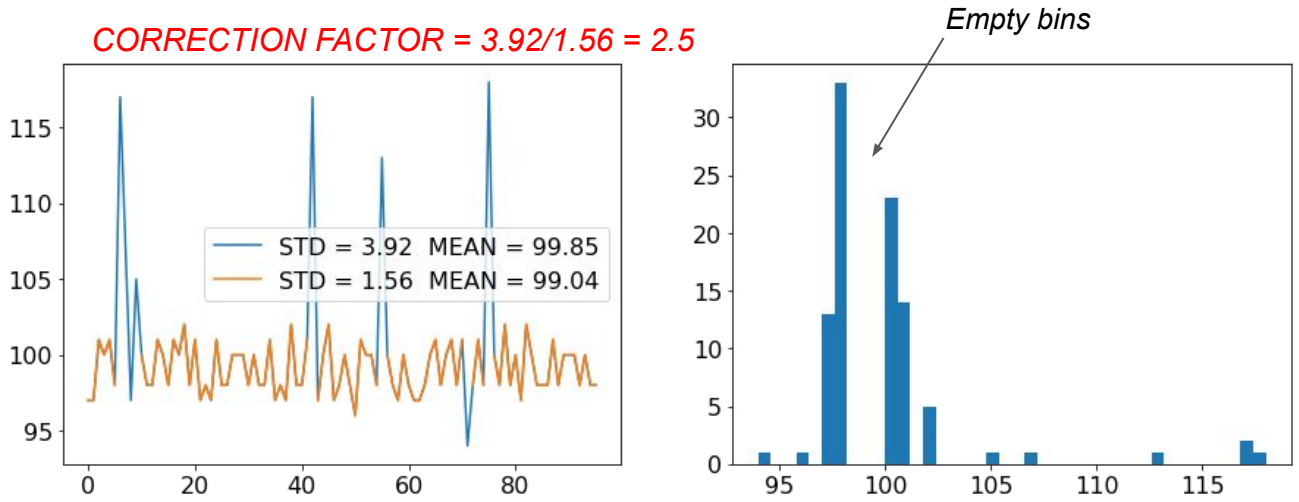
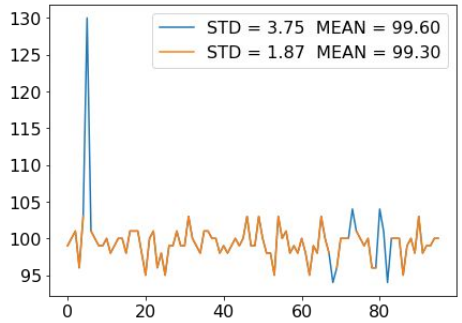
ORCA Flash sensor - Noise characteristics

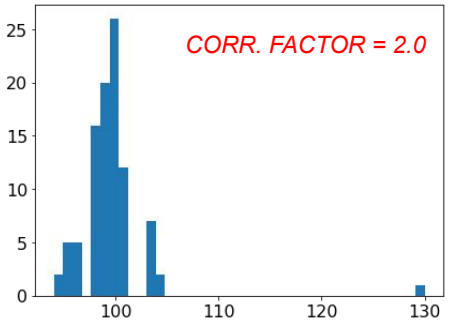
- ORCAD Flash sensor noise process
  - Non Gaussian
  - High occurrence of telegraph noise (“spikes”) **~ 20%**
  - Empty bins

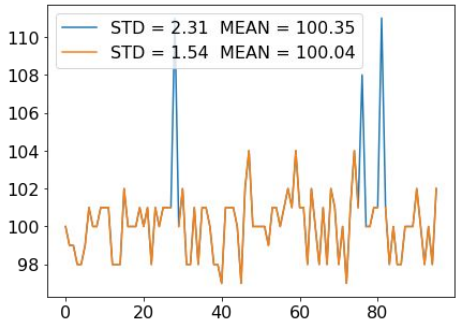


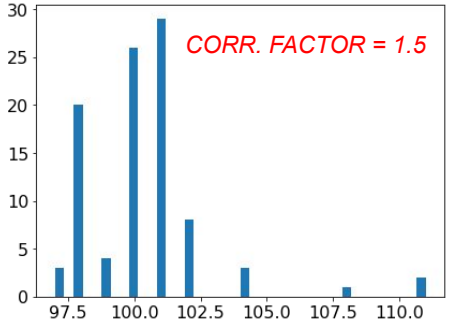
ORCA Flash sensor - Noise characteristics

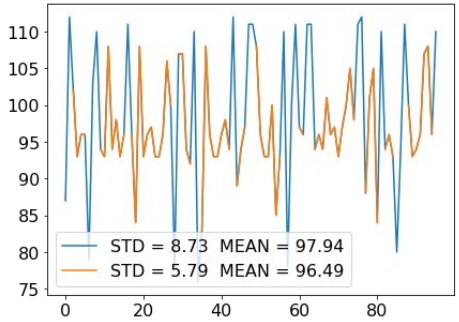
- Other examples

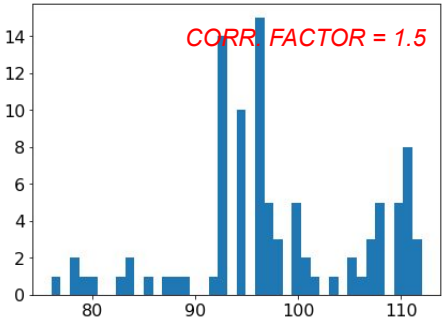


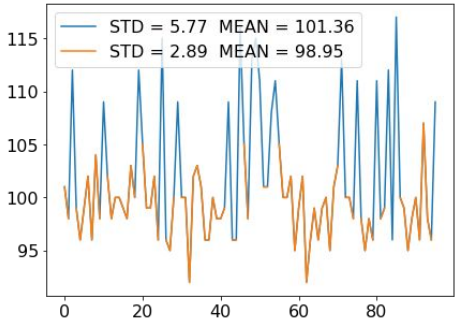


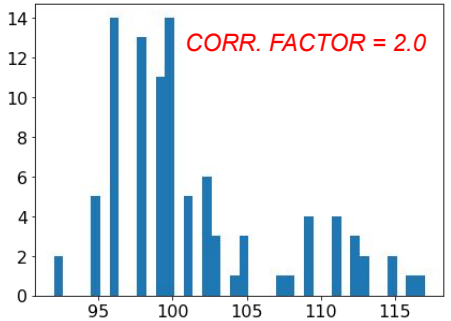




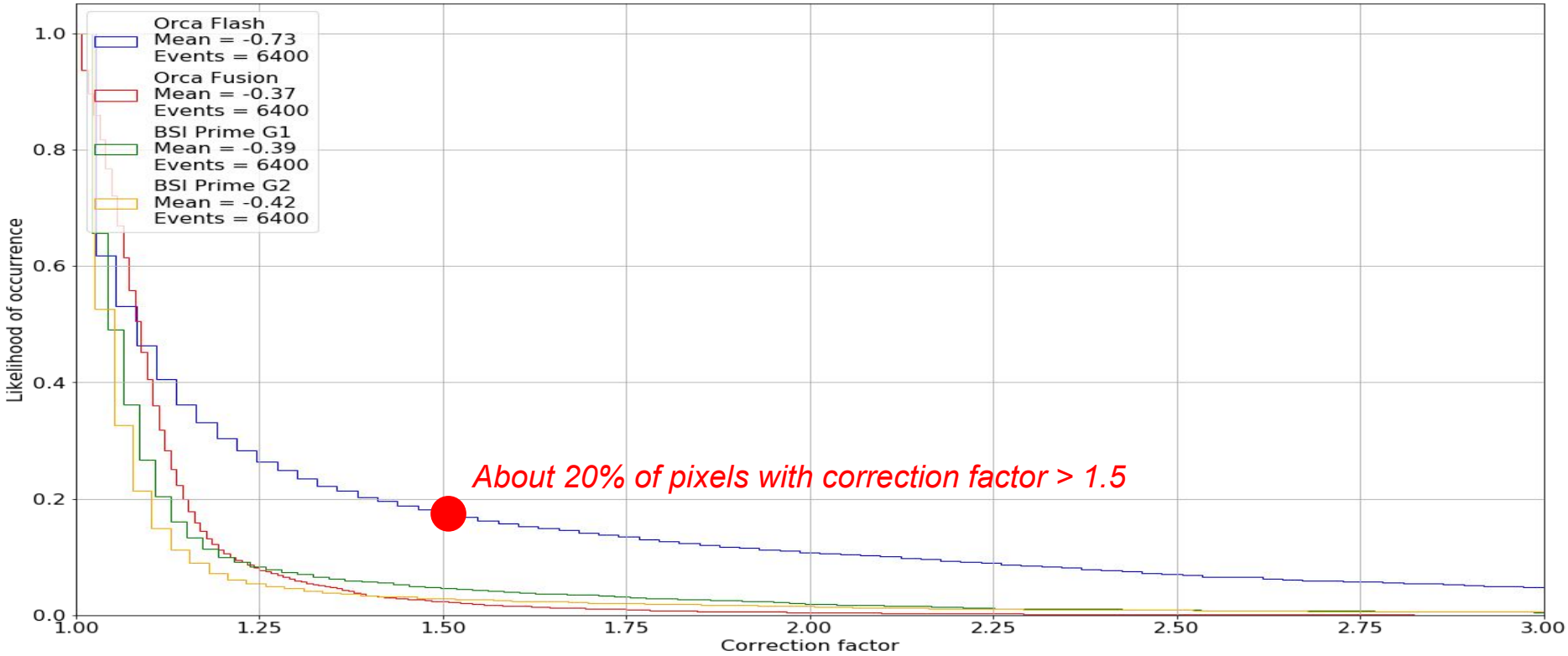






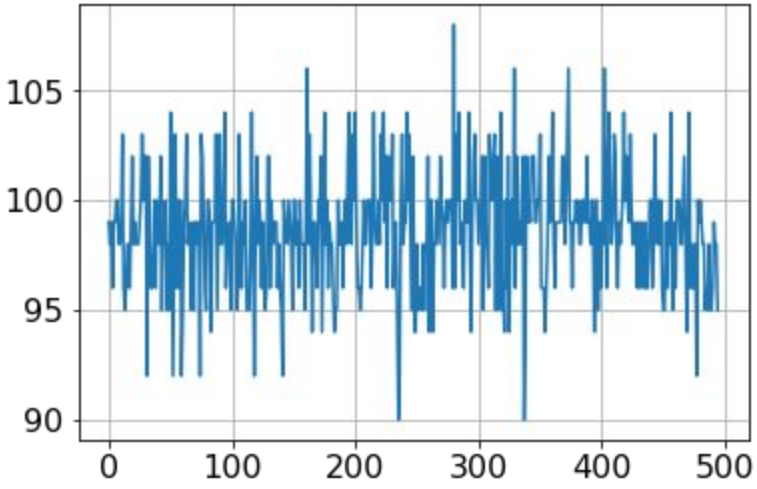


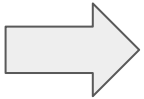
ORCA Flash sensor - Noise characteristics

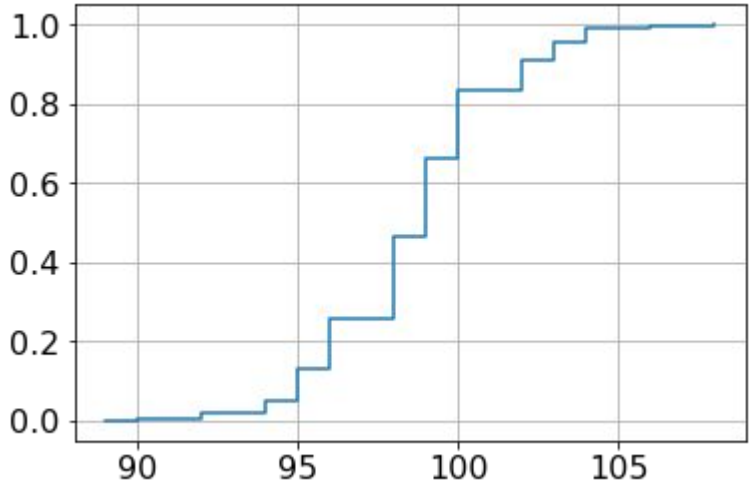


ORCA Flash sensor - Simulation proposal

- Simulate noise from its ECDF measurement
- Each pixel with its own ECDF



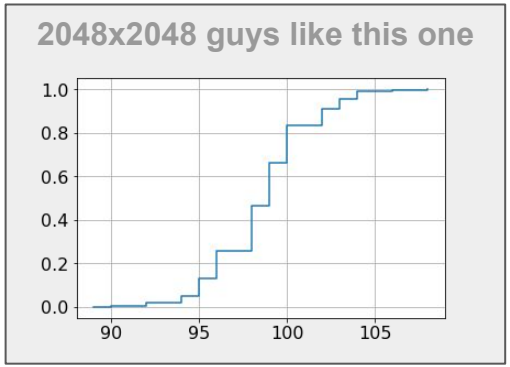




ORCA Flash sensor - Simulation proposal

Two codes are being implemented *(tests with run 2054)*:

1. Creation a ECDF_map file (~ ped_map) from a noise acquisition run

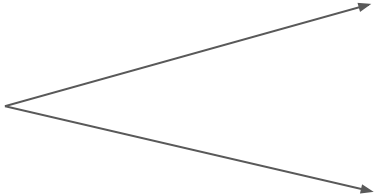


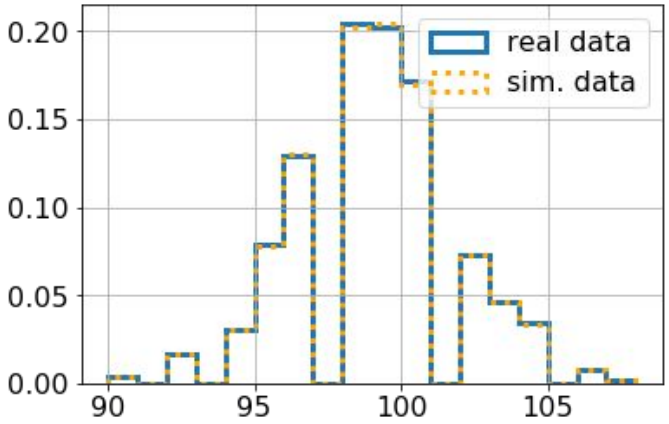
2. Simulation using ECDF_map file

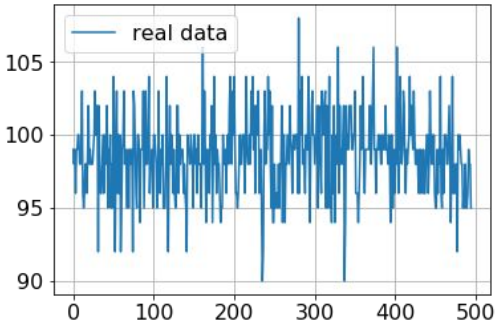
ORCA Flash sensor - Simulation proposal

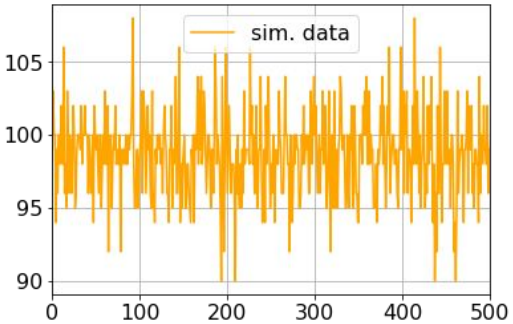
Simulating 100k samples to compare simulated and real data

Example of a pixel









ORCA Flash sensor - Simulation proposal

- Processing time to create ECDF file **= 30 min.**
  - Using a real run with 500 images (RAM limitation)
  - Each pixel having its own ECDF
  - Using only 1 CPU

- Processing time to generate noise
  = 2.5 min. for 500 images of 2048x2048

Conclusions

- Gaussian noise assumption was not compatible with our problem.
- The solution was to use ECDF in order to have a more realistic simulation.

Next steps

- Generate ~7k images and run the reconstruction algorithm to compare **simulated** and **real** sensor noise.
- Choose the right format for saving the new **ped_map** (.root, .h5, .npy), accordingly to what will be better for match with other collaboration tools;
- Implement a parallelization in GPU or CPU (if needed);
- Make the code available for the collaboration (GitHub).