Testing the efficiency of the C8P1 algorithm

Kateryna Kononenko, Washington University in St. Louis – IPM Program
Grzegorz W. Deptuch, Fermilab

Background

Charge sharing effect poses a problem when designing pixel detectors since it leads to issues in registering the correct photon signal. With the evolution of chips, it is important to find ways to minimize an effect of the charge sharing phenomenon on detecting capabilities of a chip. [1]

C8P1 algorithm is a viable solution to reduce the degrading impact introduced by charge sharing effect in pixel detectors. The main objective of this project is to evaluate the influence of C8P1 algorithm on registering the photon signals that hit the detector. This would enable better understanding of the C8P1 capabilities for future use.

Methods

The algorithm was first examined with the help of 8-ID-I beam located at the APS facility at the Argonne National Laboratory. A monochromatic X-ray beam of energy of 7.3 keV was passed vertical and horizontal slits of about 50 μm and then though a pinhole of a diameter of about 5-10 μm. [2] (Figures 2 & 3)

Consequently, software was constructed with the help of Labview where the scans were analyzed in order to understand the performance of the algorithm within the miniVipic chip framework. Histograms along with intensity plots (Figure 5) were created in order to eliminate dysfunctional pixels. After that the threshold scans (Figure 6) were plotted and the means were compared in four spots in the 2 by 2 grid to see whether it would be consistent.

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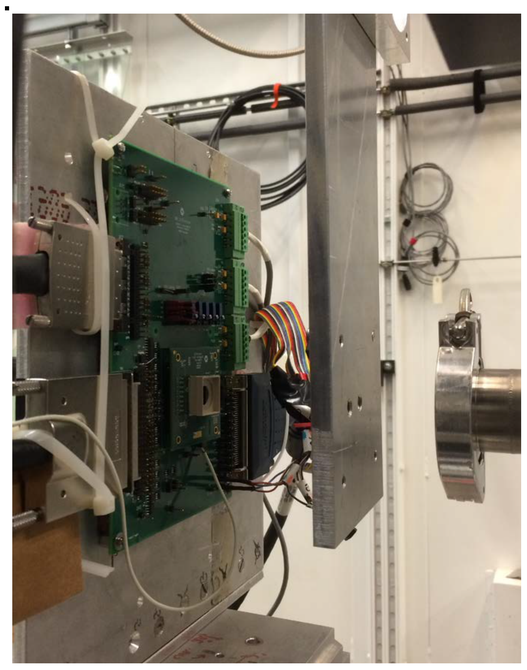


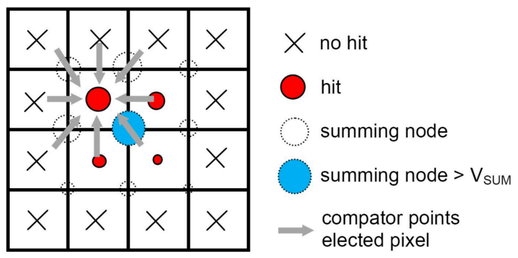
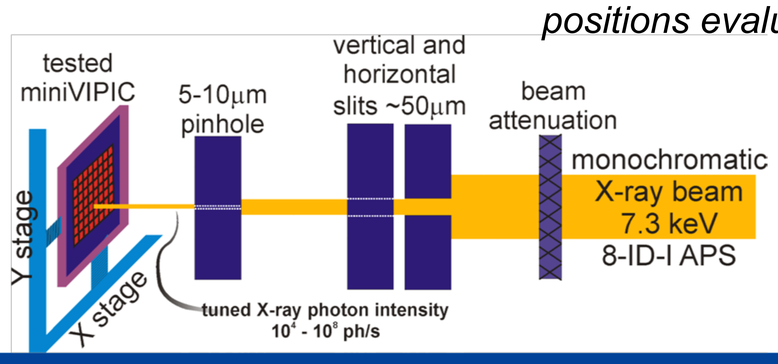
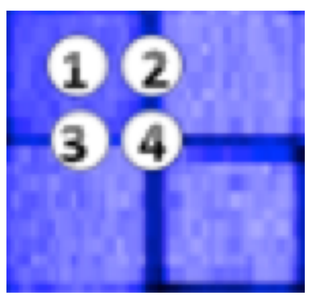


Figure 1. (above) The concept of the C8P1 algorithm.
Figure 2. (left) The set up for the beam testing of the miniVIPIC chip at Argonne National Laboratory.
Figure 3. (bottom left) The schematic arrangement of the test performed on a miniVIPIC chip.
Figure 4. (bottom right) The scheme of the positions evaluated in threshold scans.





Results

We looked at the holistic scans to recognize the defects and prevent them from being evaluated as a part of our investigation (Figure 5). After that, we plotted the threshold scans at four different positions to compare the performance of the C8P1 algorithm in these positions (Figure 6). The curves plotted for each position were very close to each other, which showed that the algorithm was acting appropriately in the scan.

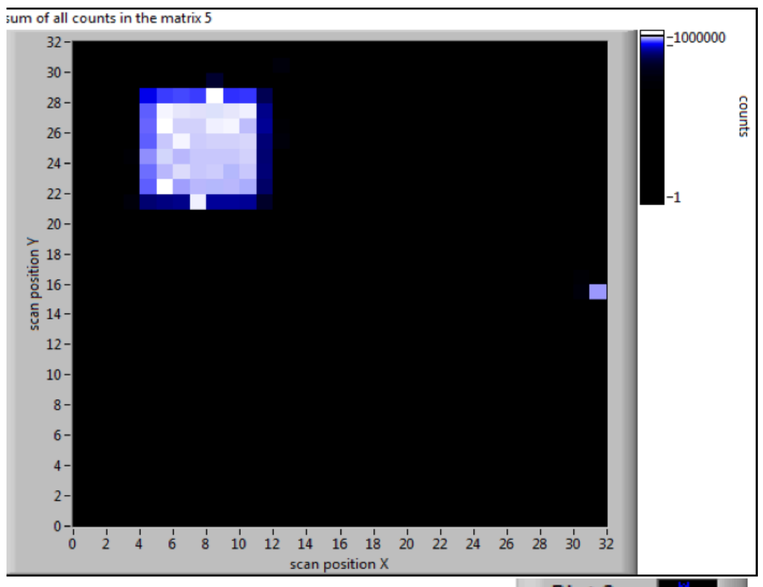


Figure 5. (top left) An example of a 32 by 32 pixel scan that has a defected pixel that had to be eliminated for further data processing.

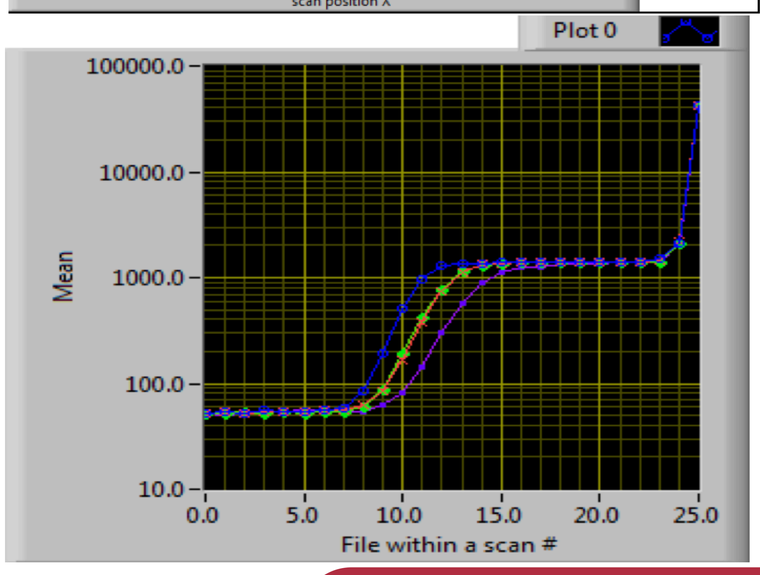


Figure 6. (bottom left) The plot for the average amount of recorded hits of a radius of 4 within four positions indicated. Purple curve correponds to position 1, green – position 3, red – position 2, green – position 4.

References

1. Baumbaugh A., Deptuch G., Grybos P., Maj P. and Szczygiel R. "Algorithms for minimization of charge sharing effects in a hybrid pixel detector taking into account hardware limitations in deep submicron technology." *Journal of Instrumentation*, December 2012.
2. Holms S. 2015."MiniVIPIC: Pixel Readout Integrated Circuit with on-chip charge cluster reconstruction for X-ray Photon Science" [PowerPoint Slides].

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