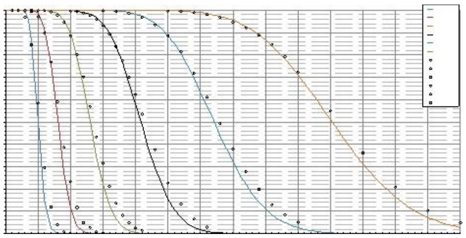
ORTHOPIX DATA COMPRESSION

Architecture and front-end for imaging detectors.



Orthopix is a method and system for compressing data arranged in a data array, and front-end read-out circuits. The proposed mapping and readout technology provides a compression factor which is independent from the number of hit elements on the detector, roughly ranging from N/2 to N/4 for the preferred implementation, where N is the side size of a reference detector made by N2 sensitive elements.

By reducing the total amount of data to be extracted from the detector, the proposed technology allows to increase the frame rate of the same amount, given a constant data bandwidth capability. This makes it possible to time-slice the incoming data, allowing to reconstruct the final image as a superimposition of single hits instead of an integrated image, increasing both spatial resolution and image structure information (time information is also available).

AREA OF EXPERTISE

- Microelectronics
- ICT

IP STATUS

- Available for licensing.

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APPLICATIONS

- Medical/material imaging.
- Electron microscopy.
- Laser beam/light beam position sensing.
- High speed and resolution tracking/aiming devices Analog PSD (Position Sensitive Device) replacement.
- There are a number of detectors/areas where we believe the architecture could have an impact, but more work is needed to correctly evaluate this. Examples of this are Gas Electron Multiplier or GEM detectors, Single Photon Avalanche Diodes or SPADs used in PET.

ADVANTAGES

- Low power (<30mW/cm), fast (< 1 clock), fixed digital input/output.
- When efficiency drops hits are not lost, but remain available for tracking.
- Flexible: double threshold for cluster tagging, further periphery compression.
- For the acquisition of sparsely populated images, the major advantages are the high spatial and time resolution plus the extremely low power consumption. The proposed technology uses a very simple pixel cell implementation, making it possible to realise small (10 by 10 microns) pixels and hence provide high spatial resolution.

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- The compression factor remains constant respect the number of hit elements in the detector, providing a constant data flux independent of the incoming signals and allowing for a much easier and less power hungry control electronic and data handling.
- The low power consumption is another key point in all those applications where:
  - Power reserve is a concern (portable devices, airborne/space applications).
  - Power distribution is a problem (very large devices/detectors).
  - Power dissipation is a problem (cryogenic detectors, in vacuum detectors, etc.).
  - Cooling is driving parameter of the system.
- Furthermore, for the acquisition of light spots position like in the PSD case, the intrinsically digital approach allows for a much lower signal to be employed and to get a position resolution independent from the signal strength (as long as it is detectable). This also mean that the device is much more resistant to the environmental noise which spoils the resolution of an analogue device even when a strong signal is applied.
- The ability to handle more than one hit per frame also makes the device much more suitable for all these applications where multiple hits per frame actually occur.
- The new front-end provides a relatively simple and very compact solution which preserves the low capacitance of the detecting element, and maintains a small pixel size. This would really be important for monolithic detectors.
- Another advantage of the present direct addressing mechanism is its (in principle) perfect robustness against multiple hits. While this is true in theory, in every practical application, the limited size of the buffers renders this robustness not absolute, even if in general better than the one offered by the proposed technology.

LIMITATIONS

- Fixed maximum hits rate, related to pixel count.
- Optimised for few pixels clusters, needs simulations for real clusters.
- Assumes uniform hits distribution. To be verified versus real physics events.

RELATED PUBLICATIONS

- Z. Li, Nuclear Instruments and Methods in Physics Research A 518 (2004), 738 – 753.
- N. Wermes, Nuclear Instruments and Methods in Physics Research A 541 (2005) 150 – 165.
- R. Horisberger, Nuclear Instruments and Methods in Physics Research A 288 (1990) 87 – 91.
- S. Avrillon et al., Nuclear Instruments and Methods in Physics Research A 386 (1997) 172 – 176.