The next generation of synchrotron fluorescence imaging for geological applications

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Energy dispersive spectra from synchrotron X-ray fluorescence (SXRF) analysis of minerals display severe multi-element overlap that can hamper imaging approaches that rely on regions of interest. A method called Dynamic Analysis (DA), developed at the CSIRO, builds a matrix transform that is applied to full-spectral pixel data to unfold the contributions of overlapping elements and project quantitative elemental images [1].

Application of the technique to geological and environmental problems using full-spectra data collected at sectors 2 (XOR, 2-ID-E) and 20 (PNC-CAT, 20-ID-B) of the APS show the value of the technique to unfold complex overlapping sequences of elemental components to extract data on metal distribution (e.g. Au) in the regolith and ore systems. User access to the technique is via the GeoPIXE software [1] installed at sectors 2, 13 and 20 of the APS.

The DA approach lends itself to real-time processing. A collaboration between the NSLS and Brookhaven Instrumentation Division and the CSIRO is working to combine BNL detector array technology with CSIRO machine vision processing approaches to achieve high throughput real-time processing of SXRF image data. The BNL detector comprises a large 384 element planar Si detector array and custom front-end chips for pulse-shaping, peak-detecting derandomization and time-over-threshold measurement [2,3,4]. The CSIRO processor (HYMOD) uses a 150 MHz FPGA and co-processor and an embedded implementation of the DA algorithm. Tests of the processor have demonstrated throughput (deconvoluted SXRF and projected elemental images) at 10^8 events per second.

References

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