Optimizing scan trajectory for x-ray fluorescence tomography.

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X-ray fluorescence (XRF) tomography aims to map trace elements within a specimen to produce a three-dimensional rendition of the sample's internal structure and elemental distribution. Unlike full-field detectors used in conventional tomography, a fluorescence detector collects photons on a per-pixel basis by scanning over a region of interest. This imaging method has the disadvantage of taking a considerably longer amount of time to complete, on the order of several hours (for small ~10-20 microns samples) to one or two days (for ~200-800 microns samples).

Here we present a scan region optimization strategy that dynamically changes the scan area as the sample rotates in effort to minimize the amount of time spent scanning background pixels and in turn reduce the total scan time. Low-resolution coarse scans collected at large angular increments are used to identify the boundary positions of a given sample and further used to generate a high-resolution scan script based on interpolated boundary values. Depending on the geometry of the sample, we can see as much as a 30% decrease in scan time, allowing users to scan more samples and get better statistics in their limited beam time. Here we present data collected using this approach from very small battery particles (10 microns) and very large soil aggregates (200-700 microns). These and future improvements are essential to bringing XRF tomography one step closer to being a routine imaging practice.