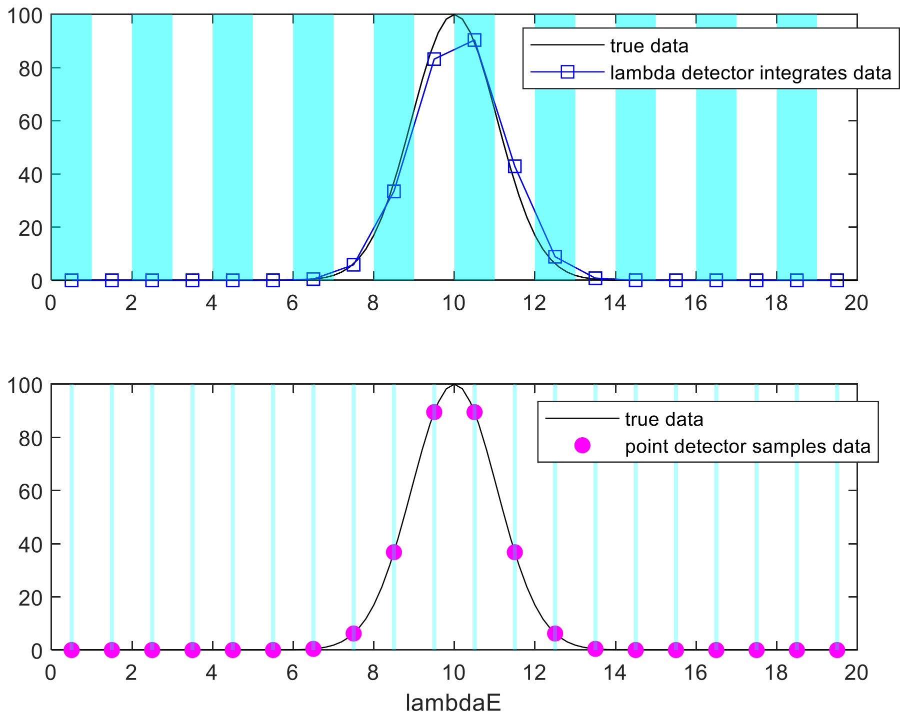
Interweaving lambdaE scans is ill-advised

Lambda (integrating) detector vs. point detector

Interweaving here means combining two scans with the same energy step size but different energy values.

If you look at a new scan and wish you had measured with a smaller energy step size it is tempting to interweave scans to try to get some more detail, for example, combining scans with lambdaE=0, 2, 4, … 20 and lambdaE=1, 3, 5, … 19. Interweaving can give you a bit more detail but does not help as much as one might think.

The lambda detector integrates over the energy step size; it does not select a particular energy. In a typical scan, the energy step size determines how many lambda pixels are binned together and so the step size also acts as a smoothing function. In other instruments (for example, one with a point detector) step size determines the sampling frequency. You measure the true signal at one point.



Comparing interwoven lambdaE scans and small step size lambdaE scans

Caveat

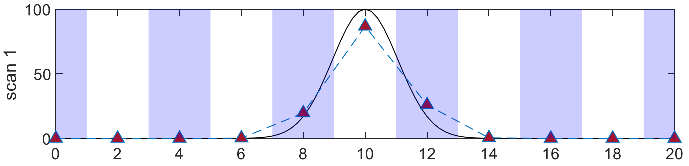
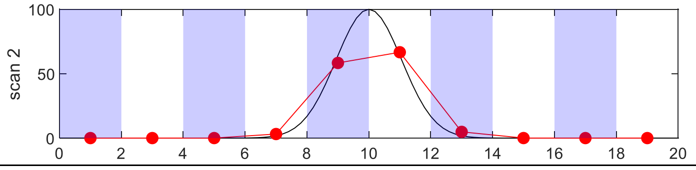
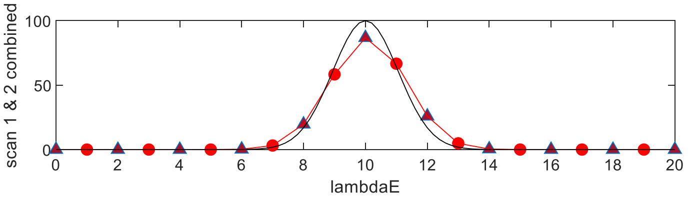
In this example I assume

1. The energy across a pixel on the lambda detector is less than the scan step size. Each data point is the sum of more than one lambda pixel.

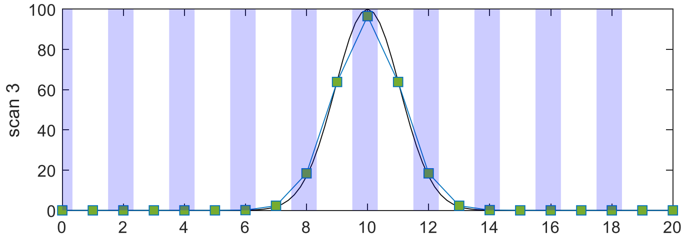
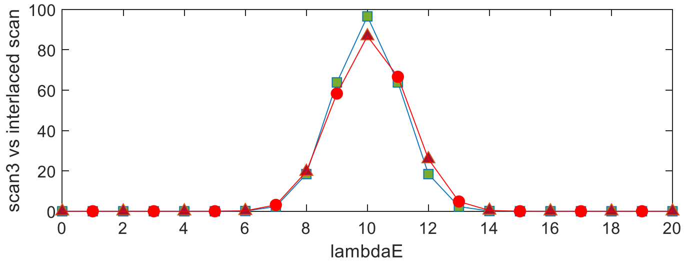
2. The feature is sharp compared to the step size. The example is a Gaussian with sigma=1.5, so a step size of 2 is really too big. If we were looking at a Gaussian with sigma=100 no difference between interwoven data and small-step-size data would be visible.

Example

Imagine we measure the two scans with the same energy step size but different energy values.

`scan #1 lambdaElup 0 20 10 1` *The scan will report back values at lambda=0, 2, 4,…20. The values will be average of all the pixels subtending the energy window.*	
`scan #2 lambdaElup 1 19 9 1` *The scan will report back values at lambda=1, 3, 5,…19.*	
Scans 1 and 2 plotted together along with true data	

Now let's compare this to a scan with a smaller step size, scan 3.

`Scan #3 lambdaElup 0 20 20 1` *The scan will report back values at lambda=0, 1, 2,…20.*	
Comparison of scan 3 and combined scans 1 and 2	

Interlacing effectively introduces a smoothing function related to the step size. The step size sets how many detector pixels are binned.

The good news is that you still have the raw TIF images and, with some effort, can regain the resolution of the strip width. It will take some coding time (I estimate 4-8 hours).