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Cross-calibration of Fuji TR image plate and RAR 2492 x-ray film to determine the response of a DITABIS Super Micron image plate

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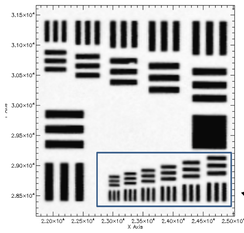
Motivation

The Fuji scanning system is no longer in service at the Z Pulsed Power Facility. A suitable replacement system was found to be the Super Micron IP scanner from DITABIS AG. A means of cross-calibrating the signal intensity to a known standard is needed.

Test pattern data from an AFTP (70μ) and a Fluke Biomedical (50μ) test pattern were used to measure scanner resolution limit



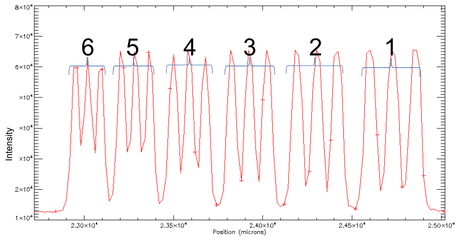
AFTP Line Pair Spacing (microns)

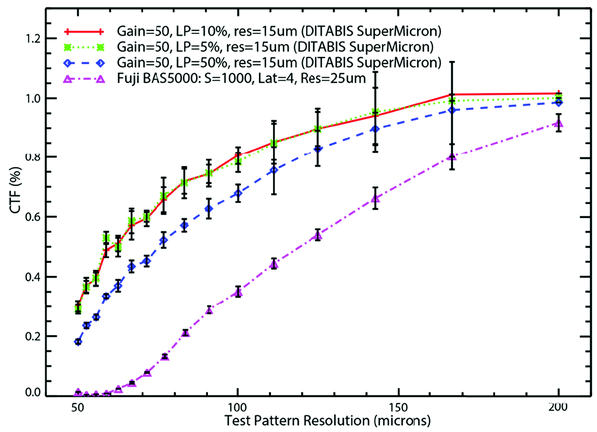
Resolution (microns)	Group Number			
Element	0	1	2	3
1	1000	500	250	125
2	890.9	445.4	222.7	111.4
3	793.7	396.9	198.4	99.2
4	707.1	353.6	176.8	88.4
5	630.0	315.0	157.5	78.7
6	561.2	280.6	140.3	70.2

Group 3 Elements 1-6

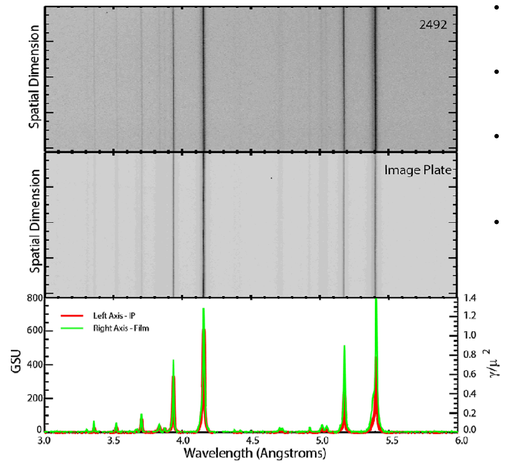
Measure the Contrast Transfer Function for each group of elements (1-6)

$$\text{CTF} = \frac{(I_{max} - I_{min})}{(I_{max} + I_{min})}$$



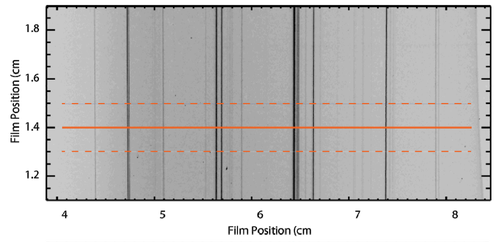


CTF Data shows that the Super Micron retains better than 25% CTF where the BAS5000 is at 0%.

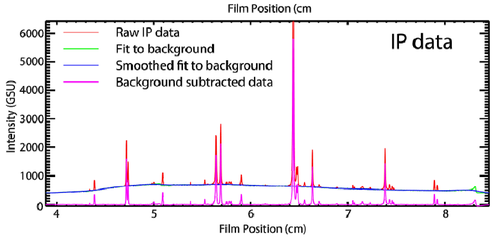


- Spectra collected simultaneously on film and IP
- 3 spectrometers used: TIXTL, CRITR, and XRS3
- Exposures made using an upgraded Manson source capable of running at up to 25 kV.
- K & L shell characteristic emission lines from Mg, Al, Si, Cr, Fe, Co, Ni, Cu, Y, Ta, and Au were used

Data Processing Steps

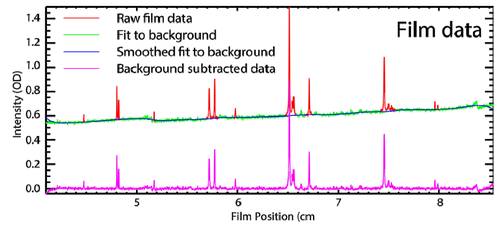


2000 m wide lineout taken through image avoiding blemishes

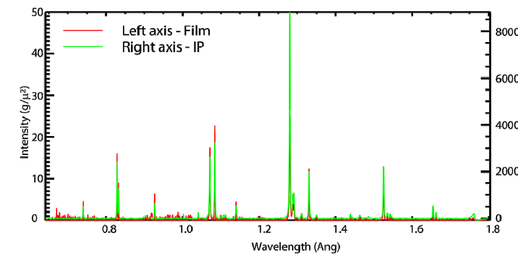


Edit peaks from lineout and smooth to fit the background signal

Subtract smoothed background from the data so that continuum is nearly zero everywhere



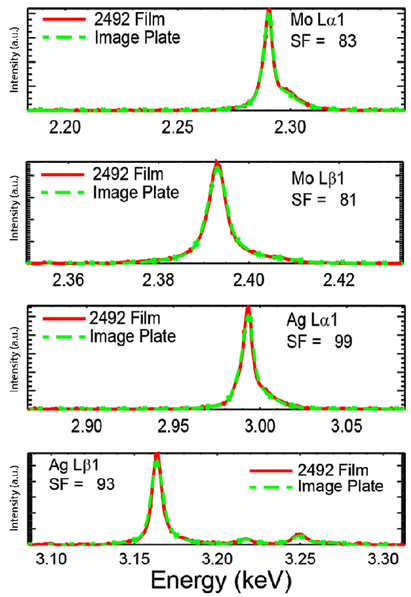
Repeat background subtraction process for x-ray film data placing it on a near-zero baseline



Convert film density to intensity using 2492 response data from Henke et. al.[1]

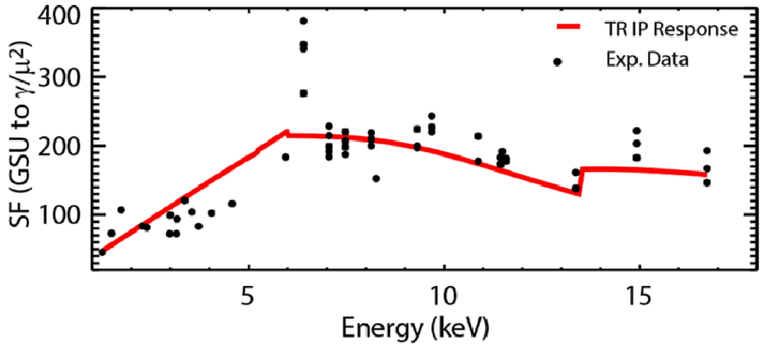
Correct IP data for fading, convert both data sets to energy scale. Determine bounds to compare lines over and extract each set.

Line Fit comparisons



Show comparisons in 3 blocks. 1 block for TIXTL data, one for CRITR and 1 for XRS3

Comparison to Shape of IP TR Response[2]



Summary/Future Work

- An energy dependent scale factor to convert 16-bit gray scale data from TR IP scanned on a DITABIS Super Micron scanner to γ/μ^2 has been empirically determined. The shape agrees with the expected IP response but more scrutiny in the energy range of the Fe Kα line is needed.
- Repeat scale factor determination for other scanning systems.
- Transition this work to MS IP and measure scale factors there.

References:

[1] B. L. Henke, E. M. Gullikson, and J. C. Davis, Atomic Data and Nuclear Data Tables **54.** 181-342 (1993).
[2] A. L. Meadowcroft *et. al.,* Rev. Sci. Instrum. **79**, 113102 (2008);

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