

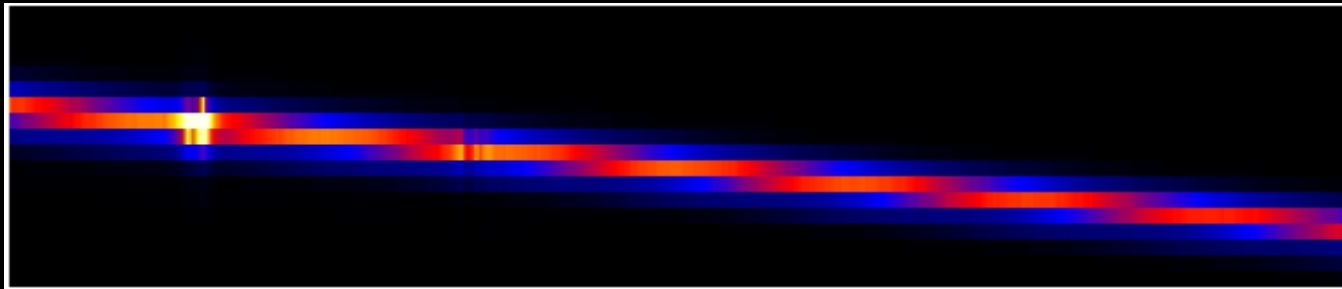
Spectral Extraction of Extended Sources Using Wavelet Interpolation

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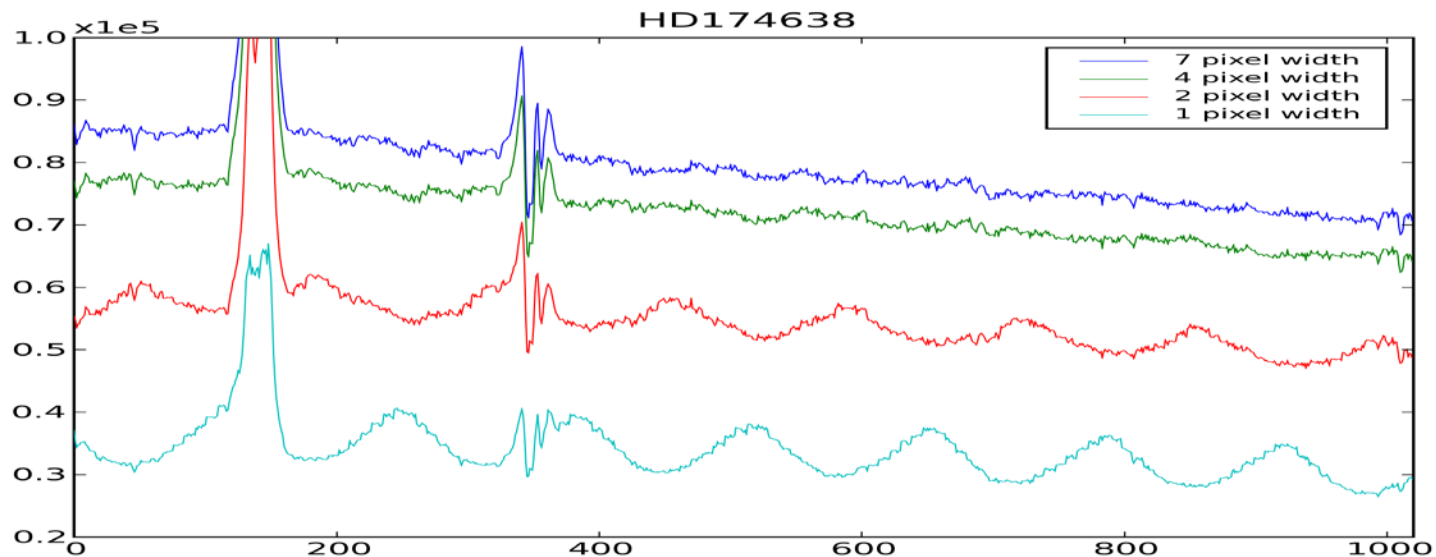
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- STIS CCD Characteristics
 - 1024 x 1024 pixels
 - ~ 0.05 arcsecond square pixels
 - $PSF = 1/[1 + (x/a)^2]^2$ where $a \sim 1.3$ pixels
 - Default extraction width for spectra is 7 pixels
- Problems with spectra of extended sources
 - Lack of spatial resolution
 - Source confusion
 - Inaccurate fluxes

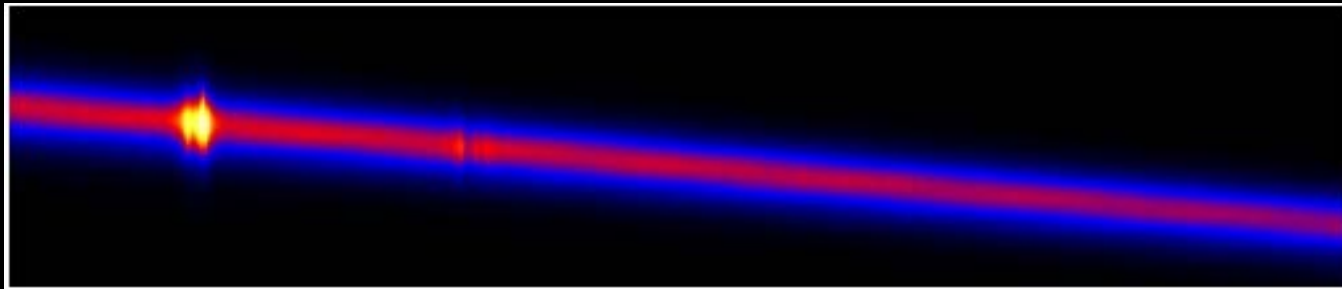
Raw spectral image of a point source showing pixel aliasing



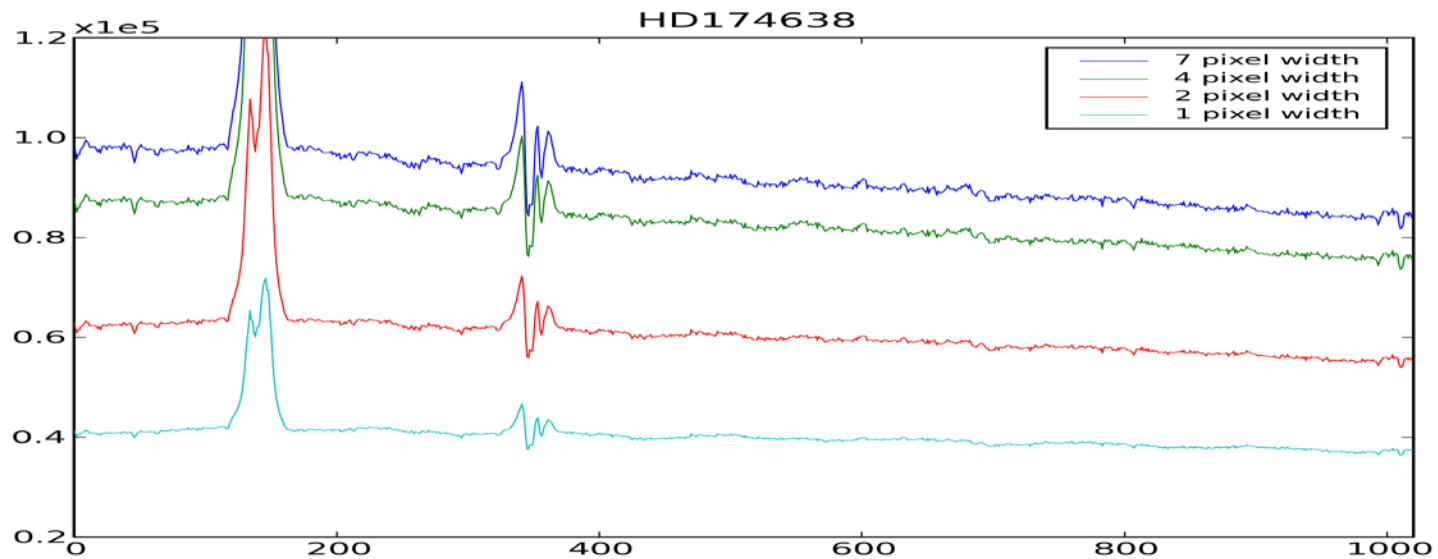
And extracted spectra for several pixel widths



An interpolated spectral image of a point source

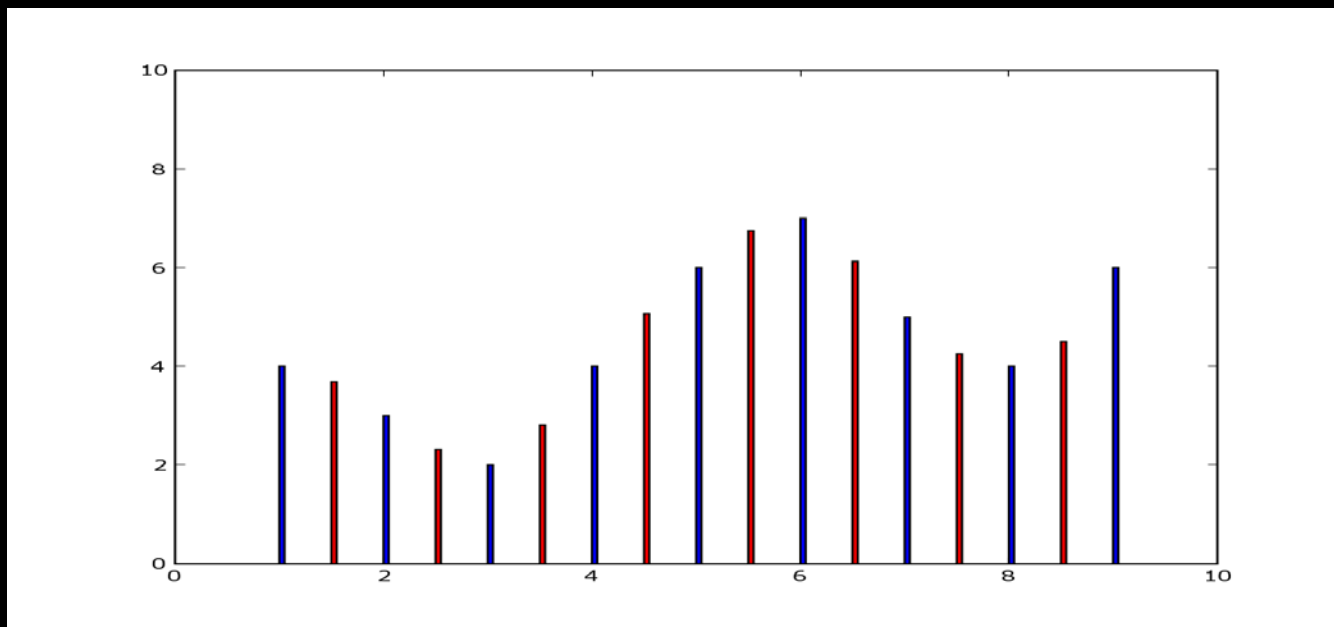


And extracted spectra for several pixel widths



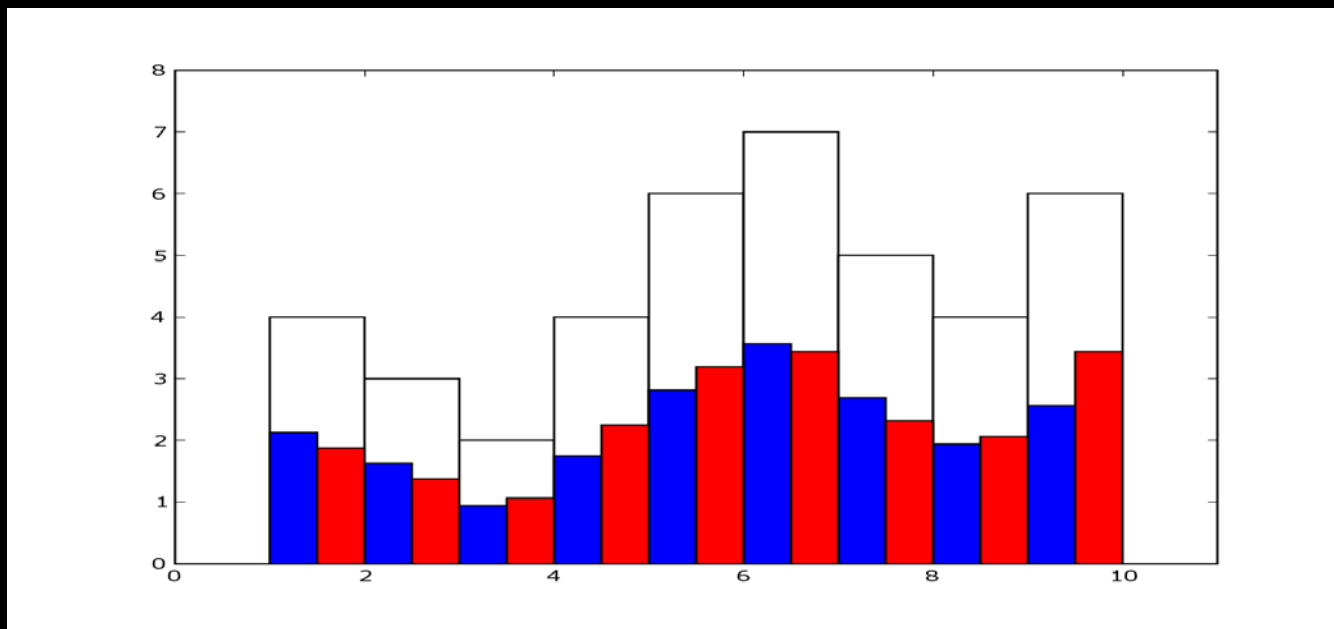
Interpolating Subdivision

- Construct a polynomial p of degree N (usually even):
 $p(x_{k+n}) = y_{k+n}$ for $-N/2+1 < n \leq N/2$
- Calculate value at midpoint: $y_{k+0.5} = p(x_{k+0.5})$



Average Interpolation Subdivision

- Construct a polynomial p of degree $N-1$ (usually odd):
 $\int p(x)dx = y_{k+n}$ for $-N/2+1 < n < N/2-1$ where $dx = [0, 1]$
- Calculate the values at k and $k+0.5$
- Note: the polynomial fits the cumulative values.

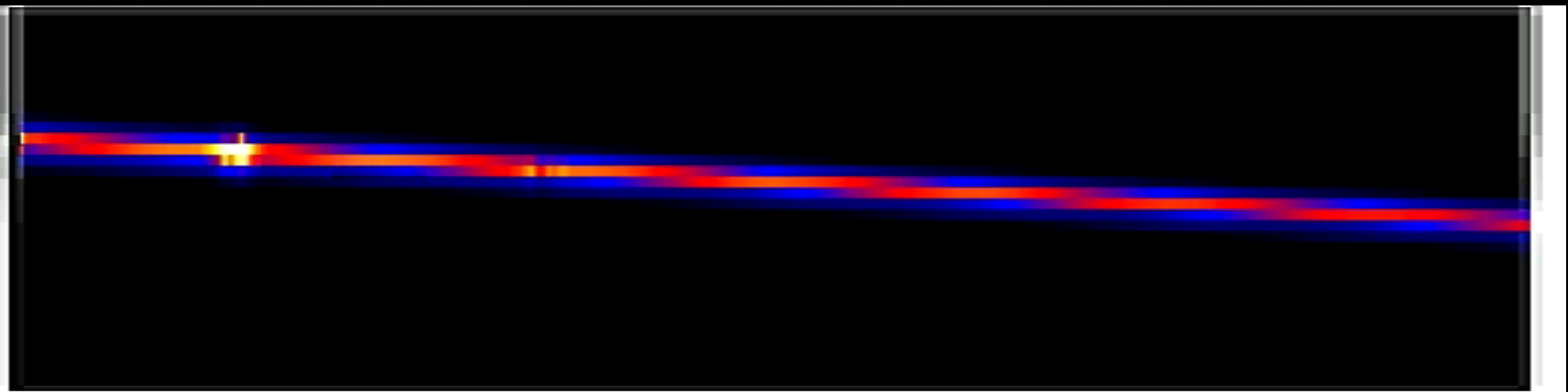


What are Wavelets?

- A subfield of harmonic analysis
- The Fourier transform
 - Depends only on frequency – a global transform
- The Short Time Fourier Transform (Gabor Transform)
 - Depends on location and frequency – a local transform
- Wavelets are local transforms with special properties
 - Satisfy the refinement relation
 - Compact support – are zero outside a specified range
 - Low (scaling function) and high (wavelet) pass filters

Average Interpolation Algorithm

1. Subdivide pixel into 2 subpixels using an N-order (=7) polynomial to partition the counts in.
2. Apply inverse Haar transform (wavelet).
3. Repeat j times.
4. Convolve subpixels using instrumental PSF



Comparison of the Method

