Imaging and Deconvolution

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1 Fourier Transform with Examples

- starting with a generic spatial image, FT to frequency image (UV), FT back to spatial image using only phase and only amplitude
- use of FT in imaging, intuative idea
- FFT vs DFT, computational scaling

1.1 Simple Skies

- FT of a single point source image (in phase centre and offset)
- FT of a two point source image (in phase centre and offset)
- FT of a Guassian source (in phase centre and offset)

1.2 Incomplete, Non-uniform Sampling

- if we have an image, go to the UV domain, remove regions, how do we reasonably reconstruct the image?
- more over, what happens if we sample some of the points in the UV domain multiple times and others never?
- the PSF is our sampling of the UV domain
- examples of sampling: random, regular/redundant, Gaussian
- examples of common arrays: VLA, KAT-7, PAPER
- weightings: uniform, natural, briggs robust

2 Cleaning the Dirty Image

- dirty image is the sky convolved with the PSF
- goal: try to decouple the PSF from the dirty image to get a clean image of the sky
- deconvolution: extract the sky model, the restored image is a biproduct, residuals are often more interesting

2.1 CLEAN Algorithm

- basic CLEAN algorithm
- variations on CLEAN for computational efficiency
- limiations: everything is a delta function, getting into the noise

2.2 Advanced Topics

- MFS and dealign with broad bandwidth
- multi-scale clean
- compressed-sensing
- W-projection
- A-projection