An Introduction to Radio Interferometry

4-4 Generalized sampling function

You can find relevant material
on my personal webpage

Sampling function (at $u_k, k = 1,2,3, \dots, M$)

Lecture Unit 4-4

$$S(u) \equiv \sum_{k=1}^{M} \delta(u - u_k)$$

Naiive inverse fourier transform

$$\left[A(\theta')\widetilde{P(\theta')}\right]^D \equiv \int S(u)V(u)e^{-i2\pi u\theta'}du$$

Generalized sampling function (at $u_k, k = 1,2,3, \ldots, M$)

$$R(u)T(u)D(u)S(u), \qquad S(u) \equiv \sum_{k=1}^{M} \delta(u - u_k)$$

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A quantity to tell effectively (i.e., considering the atmospheric transmission), how much we are affected by thermal noise (emitted by the target source, atmosphere, and our optics).

Reliability weight $R(u)$: the value is lower when the system temperature (T_{sys}) of that specific visibility measurement is higher. There is a commonly adopted functional form of $R(u_k)$. We almost always adopt it.

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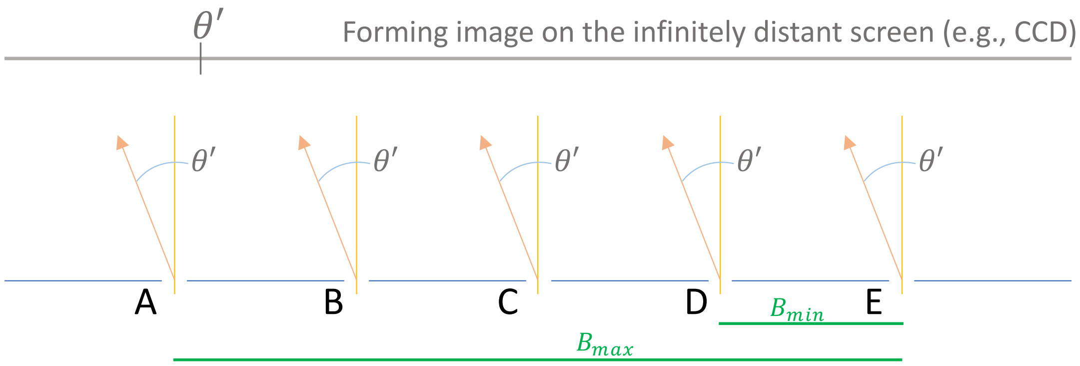
Lecture Unit 4-1



Evaluation of diffraction pattern

(proportional to the number of incoming photons in a unit of time and a unit of area)

$$E_A = E_0 \cos(kx - \omega t + \phi_0)$$

$$< (E_A + E_B + E_C + E_D + E_E + \cdots)^2 > = \overbrace{< {E_A}^2 > + < {E_B}^2 > + < {E_C}^2 > + < {E_D}^2 > + < {E_E}^2 >}^{\text{Auto-correlation}}$$

Cross-correlation

$$+ < 2E_A E_B > + < 2E_A E_C > + < 2E_A E_D > + < 2E_A E_E >$$
$$+ < 2E_B E_C > + < 2E_B E_D > + < 2E_B E_E >$$
$$+ < 2E_C E_D > + < 2E_C E_E >$$
$$+ < 2E_D E_E >$$

4 slit-pairs at shortest separation

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Natural weighting : lowest achievable noise

1. We can apply weightings to individuals of complex visibilities.
2. This is implemented by modifying the sampling function to

$$R(u)T(u)D(u)S(u) \equiv \sum_{k=1}^{M} \delta(u - u_k)R(u_k)T(u_k)D(u_k)$$

$R(u_k)$: Reliability weight $T(u_k)$: Taper $D(u_k)$: Density weighting

3. Natural weighting: $T(u) = D(u)$ =1. In most cases, it gives the best sensitivity and worst angular resolution. Uniform weighting considers $T(u)$ =1 and $D(u)$ is inversely proportional to the density of visibility. It normally gives the best angular resolution and worst sensivity.