This is just a text with beamer presentations because I want other theme colors

We want more colors

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Outline

Estimating frequency and amplitude of a single tone

Theorem

How you have fallen from heaven,
morning star, son of the dawn!
You have been cast down to the earth,
you who once laid low the nations! Isaiah 14:12

Estimating frequency and amplitude of a single tone

Given a complex sinusoid defined by:

$$r(t) = A_1 e^{j2\pi f_1 t} + z(t)$$

Where $z(t)$ is a complex Gaussian white noise with zero mean and variance σ^2.
Givens a set of samples from $r(t)$, how could we estimate the values of A_1 and f_1?

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$$\lim_{n\to\infty} M_n = \mathrm{E}\{X\}$$

Defining the PDF of the frequency

Being N the number of samples and T_s the sampling period $1/f_s$, we have.

$$\mathbf{r} = [r(0) \;\; r(T_s) \;\; r(2T_s) \;\; \ldots \;\; r((N-1)T_s)]^T$$

$$\mathbf{e_1} = [e^{j2\pi f_1 0} \; e^{j2\pi f_1 T_s} \;\; \ldots \;\; e^{j2\pi f_1 (N-1) T_s}]^T$$

$$\mathbf{r} = A_1 \mathbf{e_1} + \mathbf{n}$$

$$\mathrm{p}(\mathbf{r}|f_1, A_1) = \frac{1}{\pi^N \sigma^{2N}} \exp\left[-\frac{(\mathbf{r} - A_1\mathbf{e_1})'(\mathbf{r} - A_1\mathbf{e_1})}{\sigma^2} \right]$$

$$\mathrm{p}(\mathbf{r}|A_1) = \int \mathrm{p}(\mathbf{r}|f_1, A_1)\mathrm{p}(f_1) df_1$$

$$\mathrm{p}(f_1|\mathbf{r}, A_1) = \frac{\mathrm{p}(\mathbf{r}|f_1, A_1)\mathrm{p}(f_1)}{\mathrm{p}(\mathbf{r}|A_1)}$$