Carrier Phase Recovery

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1. Input Signal

Let the mth sample in the rth received symbol time slot be

$$Y_k(m) = X_k + V_k(m), \quad k = 1, \ldots, N, m = 1, \ldots, M. \tag{1.1}$$

where X_k is the transmitted symbol in the kth time slot and $V_k(m) \sim \mathcal{N}\left(0, \sigma^2\right)$.

2. Phase Offset

Let the phase offset be $\Delta\phi$ [?]. Then

$$Y_k = X_k e^{j2\pi\Delta\phi kM} + V_k, \quad k = 1, \ldots, N \tag{2.1}$$

From (??),

$$Y_k X_k^* = |X_k|^2 e^{j2\pi\Delta\phi kM} + X_k^* V_k \tag{2.2}$$

$$\implies r_k = e^{j2\pi\Delta\phi kM} + \bar{V}_k \tag{2.3}$$

where

$$r_k = Y_k X_k^*, \bar{V}_k = X_k^* V_k, |X_k|^2 = 1 \tag{2.4}$$

$\hat{\phi}$ can be written as:

$$\hat{\phi}_k = arg(r_k) \tag{2.5}$$

3. Phase Optimisation

This equation gives the final estimation of phase

$$\hat{\theta}_f^{(p)}(l) = \hat{\theta}_f^{(p)}(l-1) = +\alpha SAW[\hat{\theta}_f^{(p)}(l) - \hat{\theta}_f^{(p)}(l-1)] \tag{3.1}$$

Where SAW is a saw tooth non-linearity and $\alpha <= 1$

4. Plots

A. Error vs number of pilots

Fig. ?? shows the variation of the error in the offset estimate with respect to the number of pilots

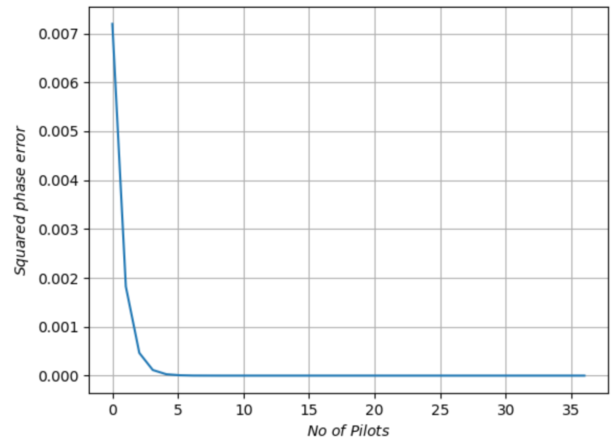

Fig. 1: Error variation with respect to number of pilots.

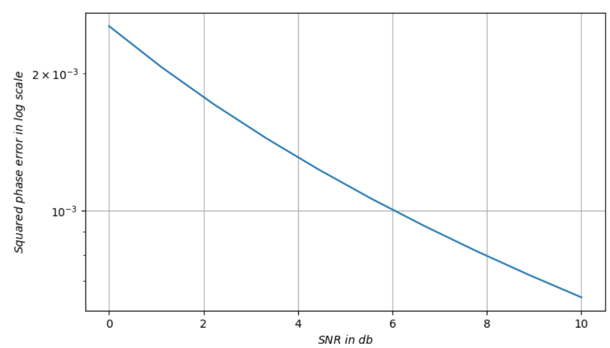

Fig. 2: Error variation with respect to SNR.

B. Error vs SNR

Next we will vary the input signal (by varying the magnitude) keeping the noise constant. Fig. ?? shows the variation of the error in the offset estimate with respect to the SNR.

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