Sub-Nyquist Cognitive Radio System

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The Calibration Process

- The calibration process estimates the transfer function of the system, the matrix \( A \).
- In the \( i \)-th step, a sine wave is injected to the system:
  \[
  x(t) = \beta_0 \sin(2\pi f_p t + \phi_0)
  \]
- To recover the skewed coefficients of the expander we use linear combinations of the output samples.
- An estimation technique recovers the coefficients of the transfer matrix \( A \).

- Least Squares (Trust Region method) minimizes the error according to:
  \[
  \hat{\beta}_0, \hat{\phi}_0 = \arg \min_{\beta, \phi} \| \hat{Y} - \beta \sin(2\pi f_m t + \phi) \|_2^2
  \]

- The transfer matrix \( A \) is produced by the calibration procedure.
- The Orthogonal Matching Pursuit (OMP) algorithm is used to detect the transmitted signal carriers.
- The signal slices are then reconstructed by inverting the matrix \( A \) reduced to the recovered support:
  \[
  \hat{y}_n = A_s \hat{z}_n \Rightarrow \hat{z}_n = A_s^\dagger \hat{y}_n
  \]
- Support recovery and reconstruction occurs in real time.

Hardware reconstruction success percentage of the calibrated matrix \( A_{\text{calibrated}} \) vs. the theoretical \( A_{\text{theory}} \).

References