Assignment-8

The due date for submitting this assignment has passed. Due on 2017-09-18, 23:59 IST.
As per our records you have not submitted this assignment.

1) Consider an $N = 4$ subcarrier OFDM system with conventional channel estimation i.e. pilot symbols transmitted on all the carriers, given as, $X(0) = 3 - j, X(1) = 2 + 3j, X(2) = -1 - 2j, X(3) = -2 + j$. The ISI channel has $L = 2$ taps, denoted by $h(0), h(1)$. Let the corresponding received samples in the time domain be $y(0) = 2 + j, y(1) = 3 + 2j, y(2) = -1 - j, y(3) = 2 - 3j$. Let the noise samples $v(k), 0 \leq k \leq 3$ be zero-mean IID Gaussian with variance $\sigma^2$. Also, let the cyclic prefix be of length one symbol. The estimate of the channel coefficient $H(3)$ across subcarrier 3 is,

\[
\frac{7}{5} - \frac{4}{5}j
\]

\[
\frac{19}{13} - \frac{22}{13}j
\]

\[
\frac{19}{10} + \frac{3}{10}j
\]

\[
\frac{2}{5} - \frac{9}{5}j
\]

No, the answer is incorrect.

Score: 0

Accepted Answers:

\[
\frac{2}{5} - \frac{4}{5}j
\]

2) Consider an $N = 4$ subcarrier OFDM system with comb type channel estimation and transmitted symbols $X(0) = 3 - j, X(1) = 2 + 3j, X(2) = -1 - 2j, X(3) = -2 + j$. The ISI channel has $L = 2$ taps, denoted by $h(0), h(1)$. Let $l = 0, 3$ denote the pilot subcarriers. Let the corresponding received samples in the time domain be $y(0) = 2 + j, y(1) = 3 + 2j, y(2) = -1 - j, y(3) = 2 - 3j$. Let the noise samples $v(k), 0 \leq k \leq 3$ be zero-mean IID Gaussian with variance $\sigma^2$. Also, let the cyclic prefix be of length two symbols. The estimate of the channel tap $h(0)$ is,

\[
\frac{22}{10} - \frac{5}{10}j
\]
Consider a Frequency Domain Equalization system with block length $N$. Let the variance at time $l$ be IID Gaussian noise with zero-mean and $10^{-22}$ variance respectively at the corresponding received symbol vector at time $l$. Let $\mathbf{p}$ be the pilot vector of transmitted pilot symbols at time $l$. Let $\mathbf{x}$ denote the channel coefficient, pilot symbol and noise sample respectively. The estimate of the transmitted symbol $x(k)$ is given as:

$$
\hat{x}(k) = \frac{1}{N-1} \sum_{i=0}^{N-1} \frac{Y(i)}{H(i)} e^{-j2\pi \frac{i}{N}} 
$$

4) Consider a sequential fading channel estimation problem where the output symbol $y(k)$ is $y(k) = hx(k) + v(k)$, with $h$, $x(k)$, $v(k)$ denoting the real channel coefficient, pilot symbol and noise sample respectively. Let $\mathbf{x} = [-2\ 3\ \ 2]^T$ denote the pilot vector of transmitted pilot symbols at $N = 3$ and $\mathbf{y} = [3\ 2\ -1]^T$ denote the corresponding received symbol vector at $N = 3$. Let the transmitted and received symbols respectively at $N + 1 = 4$ be $x(4) = -1$, $y(4) = -2$ respectively. Let $v(k)$ be IID Gaussian noise with zero-mean and dB variance $\sigma^2 = -3\ dB$. Let $p(N)$ denote the variance at time $N$. The expression for the gain $K(N + 1)$ at time $N + 1$ is:

$$
K(N + 1) = \frac{p(N)x(N+1)}{\sigma^2 + p(N)x^2(N+1)}
$$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$$
\frac{p(N)x(N+1)}{\sigma^2 + p(N)x^2(N+1)}
$$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$$
\frac{p(N)x(N+1)}{\sigma^2 + p(N)x^2(N+1)}
$$
5) Consider a sequential fading channel estimation problem where the output symbol \( y(k) \) is \( y(k) = hx(k) + v(k) \), with \( h \), \( x(k) \), \( v(k) \) denoting the real channel coefficient, pilot symbol and noise sample respectively. Let \( x = [-2 \ 3 \ 2]^T \) denote the pilot vector of transmitted pilot symbols at \( N = 3 \) and \( y = [3 \ -2 \ -1]^T \) denote the corresponding received symbol vector at \( N = 3 \). Let the transmitted and received symbols respectively at \( N + 1 = 4 \) be \( x(4) = -1 \), \( y(4) = -2 \) respectively. Let \( v(k) \) be IID Gaussian noise with zero-mean and dB variance \( \sigma^2 = -3dB \). Let \( p(N) \) denote the variance at time \( N \). The gain \( K(N + 1) \) at time \( N + 1 = 4 \) is,

\[
\begin{align*}
&-\frac{1}{16} \\
&-\frac{1}{17} \\
&-\frac{1}{18} \\
&-\frac{1}{19}
\end{align*}
\]

No, the answer is incorrect.
Score: 0
Accepted Answers:
\(-\frac{1}{18}\)

6) Consider a sequential fading channel estimation problem where the output symbol \( y(k) \) is \( y(k) = hx(k) + v(k) \), with \( h \), \( x(k) \), \( v(k) \) denoting the real channel coefficient, pilot symbol and noise sample respectively. Let \( x = [-2 \ 3 \ 2]^T \) denote the pilot vector of transmitted pilot symbols at \( N = 3 \) and \( y = [3 \ 2 \ -1]^T \) denote the corresponding received symbol vector at \( N = 3 \). Let the transmitted and received symbols respectively at \( N + 1 = 4 \) be \( x(4) = -1 \), \( y(4) = -2 \) respectively. Let \( v(k) \) be IID Gaussian noise with zero-mean and dB variance \( \sigma^2 = -3dB \). Let \( p(N) \) denote the variance at time \( N \). The prediction error at time \( N + 1 = 4 \) is,

\[
\begin{align*}
&-\frac{18}{17} \\
&-\frac{16}{17} \\
&-\frac{34}{17} \\
&-\frac{32}{17}
\end{align*}
\]

No, the answer is incorrect.
Score: 0
Accepted Answers:
\(-\frac{36}{17}\)

7) Consider a sequential fading channel estimation problem where the output symbol \( y(k) \) is \( y(k) = hx(k) + v(k) \), with \( h \), \( x(k) \), \( v(k) \) denoting the real channel coefficient, pilot symbol and noise sample respectively. Let \( x = [1 \ -1 \ 1]^T \) denote the pilot vector of transmitted pilot symbols at \( N = 3 \) and \( y = [2 \ -1 \ -3]^T \) denote the corresponding received symbol vector at \( N = 3 \). Let the transmitted and received symbols respectively at \( N + 1 = 4 \) be \( x(4) = -1 \), \( y(4) = -1 \) respectively. Let \( v(k) \) be IID Gaussian noise with zero-mean and dB variance \( \sigma^2 = -3dB \). What is the prediction error at time \( N + 1 = 4 \) is,

\[
\begin{align*}
&1
\end{align*}
\]
8) Consider a sequential fading channel estimation problem where the output symbol \( y(k) \) is \( y(k) = h x(k) + v(k) \), with \( h \), \( x(k) \), \( v(k) \) denoting the real channel coefficient, pilot symbol and noise sample respectively. Let \( x = [1 \ -1 \ 1]^T \) denote the pilot vector of transmitted pilot symbols at \( N = 3 \) and \( y = [2 \ -\frac{1}{2} \ \frac{3}{2}]^T \) denote the corresponding received symbol vector at \( N = 3 \). Let the transmitted and received symbols respectively at \( N + 1 \) be \( x(4) = -1 \), \( y(4) = -1 \) respectively. Let \( v(k) \) be IID Gaussian noise with zero-mean and dB variance \( \sigma^2 = -3 dB \). The gain \( K(4) \) at time \( N + 1 \) is,

\[
\begin{align*}
0 \\
\frac{1}{2} \\
\frac{1}{4} \\
\frac{1}{2}
\end{align*}
\]

No, the answer is incorrect.
Score: 0
Accepted Answers: 0

9) Consider a sequential fading channel estimation problem where the output symbol \( y(k) \) is \( y(k) = h x(k) + v(k) \), with \( h \), \( x(k) \), \( v(k) \) denoting the real channel coefficient, pilot symbol and noise sample respectively. Let \( x = [1 \ -1 \ 1]^T \) denote the pilot vector of transmitted pilot symbols at \( N = 3 \) and \( y = [2 \ -\frac{1}{2} \ \frac{3}{2}]^T \) denote the corresponding received symbol vector at \( N = 3 \). Let the transmitted and received symbols respectively at \( N + 1 = 4 \) be \( x(4) = -1 \), \( y(4) = -1 \) respectively. Let \( v(k) \) be IID Gaussian noise with zero-mean and dB variance \( \sigma^2 = -3 dB \). The update i.e. quantity to be added to estimate \( \hat{h}(3) \) at \( N = 3 \) to generate the estimate \( \hat{h}(4) \) at time \( N + 1 = 4 \) is,

\[
\begin{align*}
0 \\
\frac{1}{2} \\
\frac{1}{3} \\
\frac{1}{4} \\
0
\end{align*}
\]

No, the answer is incorrect.
Score: 0
Accepted Answers: 0
Consider a sequential fading channel estimation problem where the output symbol $y(k)$ is $y(k) = h x(k) + v(k)$, with $h$, $x(k)$, $v(k)$ denoting the real channel coefficient, pilot symbol and noise sample respectively. Let $\mathbf{x} = [1 \ -1 \ 1]^T$ denote the pilot vector of transmitted pilot symbols at $N = 3$ and $\mathbf{y} = [2 \ \frac{1}{2} \ \frac{3}{2}]^T$ denote the corresponding received symbol vector at $N = 3$. Let the transmitted and received symbols respectively at $N + 1 = 4$ be $x(4) = -1$, $y(4) = -1$ respectively. Let $v(k)$ be IID Gaussian noise with zero-mean and dB variance $\sigma^2 = -3d_B$. The variance of the estimate $\hat{h}(4)$ at time $N + 1 = 4$ is,

- $\frac{1}{4}$
- $\frac{1}{8}$
- $\frac{1}{10}$
- $\frac{1}{16}$

No, the answer is incorrect.
Score: 0
Accepted Answers: $\frac{1}{8}$