

- 6.8. The autocorrelation of a discrete-time signal $x[n]$ is defined by

$$R_x[n] = \sum_{i=-\infty}^{\infty} x[i]x[n+i]$$

Let $P_x(\Omega)$ denote the DTFT of $R_x[n]$.

- (a) Derive an expression for $P_x(\Omega)$ in terms of the DTFT $X(\Omega)$ of $x[n]$.
 - (b) Derive an expression for $R_x[-n]$ in terms of $R_x[n]$.
 - (c) Express $P_x(0)$ in terms of $x[n]$.
- 6.9. Compute the rectangular form of the four-point DFT of the following signals, all of which are zero for $n < 0$ and $n \geq 4$.
- (a) $x[0] = 1, x[1] = 0, x[2] = 1, x[3] = 0$
 - (b) $x[0] = 1, x[1] = 0, x[2] = -1, x[3] = 0$
 - (c) $x[0] = 1, x[1] = 1, x[2] = -1, x[3] = -1$
 - (d) $x[0] = -1, x[1] = 1, x[2] = 1, x[3] = 1$
 - (e) $x[0] = -1, x[1] = 0, x[2] = 1, x[3] = 2$
 - (f) $x[0] = 1, x[1] = -1, x[2] = 1, x[3] = -1$
 - (g) Compute the DFT for each of the signals above using the MATLAB M-file `dft`. Compare these results to the results obtained analytically in parts (a) to (f).
- 6.10. Using the MATLAB M-file `dft`, compute the 32-point DFT of the following signals. Express your answer by plotting the amplitude $|X_k|$ and phase $\angle X_k$ of the DFTs.
- (a) $x[n] = 1, 0 \leq n \leq 10, x[n] = 0$ for all other n
 - (b) $x[n] = 1, 0 \leq n \leq 10, x[n] = -1, 11 \leq n \leq 20, x[n] = 0$ for all other n
 - (c) $x[n] = n, 0 \leq n \leq 20, x[n] = 0$ for all other n
 - (d) $x[n] = n, 0 \leq n \leq 10, x[n] = 20 - n, 11 \leq n \leq 20, x[n] = 0$ for all other n
 - (e) $x[n] = \cos(10\pi n/11), 0 \leq n \leq 10, x[n] = 0$ for all other n
 - (f) $x[n] = \cos(9\pi n/11), 0 \leq n \leq 10, x[n] = 0$ for all other n
- 6.11. Using the MATLAB M-file `dft`, compute the magnitude of the 32-point DFT X_k of the following signals.

$$(a) \ x[n] = \begin{cases} 1, & n = 0 \\ \frac{1}{n}, & n = 1, 2, 3, \dots, 31 \\ 0, & n = 32, 33, \dots \end{cases}$$

$$(b) \ x[n] = \begin{cases} 1, & n = 0 \\ \frac{1}{n^2}, & n = 1, 2, 3, \dots, 31 \\ 0, & n = 32, 33, \dots \end{cases}$$

$$(c) \ x[n] = \begin{cases} 1, & n = 0 \\ \frac{1}{n!}, & n = 1, 2, 3, \dots, 31 \\ 0, & n = 32, 33, \dots \end{cases}$$

- (d) Compare the results obtained for parts (a) to (c). Explain the differences in the results.

6.12. Consi

where
sequ
terpr
point
of $x[n]$

6.13. For e
time i

6.14 For e
press

6.15 Comp
(a) x

(b) x

(c) x

(d) x

6.16. Usin
DFT

6.17. Com
nals

6.18. Use
ted i
Com
 $\Omega =$

6.19. To c
DFT
(a)

(b)

(c)

(d)

6.20. An