

6.7.1 Discrete-Time Fourier Transform

6.7.1 Discrete-Time Fourier Transform (DTFT)

$$Y_n = \sum_{k=-\infty}^{\infty} X_{n-k}$$

Discrete-Time Fourier Transform (DTFT) is a continuous function of frequency ω .

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$$X_n = e^{i\omega n}$$

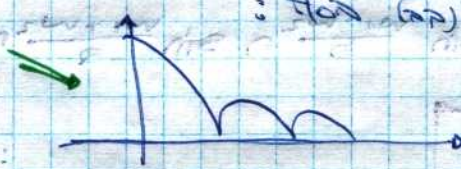
$$Y_n = \frac{1}{L} \sum_{k=-\infty}^{\infty} e^{i\omega(n-k)} = \frac{1}{L} \sum_{k=-\infty}^{\infty} e^{i\omega k} e^{i\omega n}$$

For a discrete-time signal X_n , the DTFT is a continuous function of frequency ω .

$$\sum_{n=-L/2}^{L/2} (e^{i\omega})^n = \frac{1 - e^{i\omega L}}{1 - e^{i\omega}}$$

$$= \frac{e^{i\omega L/2} (e^{-i\omega L/2} - e^{i\omega L/2})}{e^{i\omega L/2} (e^{-i\omega/2} - e^{i\omega/2})} = \frac{e^{i\omega L/2} \sin(L\omega/2)}{e^{i\omega L/2} \sin(\omega/2)}$$

$$e^{-i\omega L/2} \cdot \frac{1}{L} \frac{\sin(L\omega/2)}{\sin(\omega/2)}$$



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$$X_n = Q_1 \cos \omega_1 n + Q_2 \cos \omega_2 n + Q_3 \cos \omega_3 n + \dots$$

↓
ଗୋଟିଏ ସମ୍ବଳ

$$Y_n = Q_1 \sin \omega_1 n + Q_2 \sin \omega_2 n + Q_3 \sin \omega_3 n$$

ଏହାକୁ ଏକ ସମ୍ବଳ ଭାବରେ ନେଇ ଏହାକୁ 90° ଡିଗ୍ରୀ ଫେରିବା ପାଇଁ $\sin$ ର ସ୍ଥାନ $\cos$ ର ସ୍ଥାନରେ ବଦଳାଇ ଦିଆଯାଏ।

ଏହାକୁ 90° ଡିଗ୍ରୀ ଫେରିବା ପାଇଁ $\sin$ ର ସ୍ଥାନ $\cos$ ର ସ୍ଥାନରେ ବଦଳାଇ ଦିଆଯାଏ।

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$$X_n = A(t) \cos \Phi(t)$$

$$Y_n = A(t) \sin \Phi(t)$$

ଏହାକୁ 90° ଡିଗ୍ରୀ ଫେରିବା ପାଇଁ $\sin$ ର ସ୍ଥାନ $\cos$ ର ସ୍ଥାନରେ ବଦଳାଇ ଦିଆଯାଏ।

$$\cos x + \cos y = \cos \frac{x+y}{2} \cdot \cos \frac{x-y}{2}$$

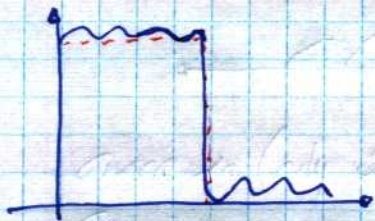
$$\sin x + \sin y = \sin \frac{x+y}{2} \cdot \sin \frac{x-y}{2}$$

ଏହାକୁ 90° ଡିଗ୍ରୀ ଫେରିବା ପାଇଁ $\sin$ ର ସ୍ଥାନ $\cos$ ର ସ୍ଥାନରେ ବଦଳାଇ ଦିଆଯାଏ।

$$X_n = Q_1 \cos \omega_1 n + Q_2 \cos \omega_2 n = Q \cos \frac{\omega_1 - \omega_2}{2} n \cos \frac{\omega_1 + \omega_2}{2} n$$

ଏହାକୁ 90° ଡିଗ୍ରୀ ଫେରିବା ପାଇଁ $\sin$ ର ସ୍ଥାନ $\cos$ ର ସ୍ଥାନରେ ବଦଳାଇ ଦିଆଯାଏ।

$$= a \sin \frac{\omega_1 - \omega_2}{2} n \sin \frac{\omega_1 + \omega_2}{2} n$$



ଏହାକୁ 90° ଡିଗ୍ରୀ ଫେରିବା ପାଇଁ $\sin$ ର ସ୍ଥାନ $\cos$ ର ସ୍ଥାନରେ ବଦଳାଇ ଦିଆଯାଏ।

6.7.3

ଏହାକୁ 90° ଡିଗ୍ରୀ ଫେରିବା ପାଇଁ $\sin$ ର ସ୍ଥାନ $\cos$ ର ସ୍ଥାନରେ ବଦଳାଇ ଦିଆଯାଏ।

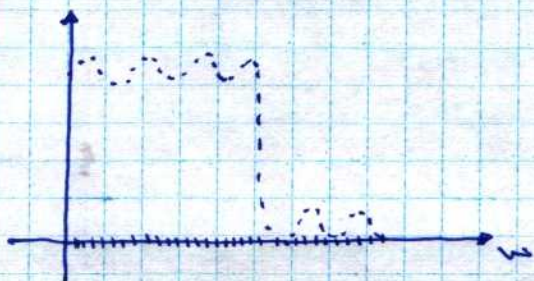
ଏହାକୁ 90° ଡିଗ୍ରୀ ଫେରିବା ପାଇଁ $\sin$ ର ସ୍ଥାନ $\cos$ ର ସ୍ଥାନରେ ବଦଳାଇ ଦିଆଯାଏ।

ଏହାକୁ 90° ଡିଗ୍ରୀ ଫେରିବା ପାଇଁ $\sin$ ର ସ୍ଥାନ $\cos$ ର ସ୍ଥାନରେ ବଦଳାଇ ଦିଆଯାଏ।

$$H(\omega) = |H(\omega)| e^{j\phi(\omega)}$$

ଏହାକୁ 90° ଡିଗ୍ରୀ ଫେରିବା ପାଇଁ $\sin$ ର ସ୍ଥାନ $\cos$ ର ସ୍ଥାନରେ ବଦଳାଇ ଦିଆଯାଏ।

$$\sum Q_n e^{j\omega_n n} \sin \omega_n n$$



ଏହାକୁ 90° ଡିଗ୍ରୀ ଫେରିବା ପାଇଁ $\sin$ ର ସ୍ଥାନ $\cos$ ର ସ୍ଥାନରେ ବଦଳାଇ ଦିଆଯାଏ।

6.88

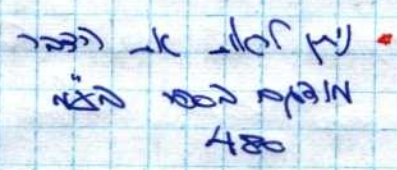
111. ~~2~~ קונטרס



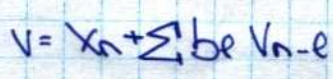
1. $\frac{1}{x^2} = x^{-2}$
 $\frac{d}{dx} x^{-2} = -2x^{-3} = -\frac{2}{x^3}$
 $\frac{d}{dx} \frac{1}{x^2} = -\frac{2}{x^3}$
 2. $\frac{d}{dx} \frac{1}{x^3} = \frac{d}{dx} x^{-3} = -3x^{-4} = -\frac{3}{x^4}$
 $\frac{d}{dx} \frac{1}{x^3} = -\frac{3}{x^4}$
 3. $\frac{d}{dx} \frac{1}{x^4} = \frac{d}{dx} x^{-4} = -4x^{-5} = -\frac{4}{x^5}$
 $\frac{d}{dx} \frac{1}{x^4} = -\frac{4}{x^5}$
 4. $\frac{d}{dx} \frac{1}{x^5} = \frac{d}{dx} x^{-5} = -5x^{-6} = -\frac{5}{x^6}$
 $\frac{d}{dx} \frac{1}{x^5} = -\frac{5}{x^6}$
 5. $\frac{d}{dx} \frac{1}{x^6} = \frac{d}{dx} x^{-6} = -6x^{-7} = -\frac{6}{x^7}$
 $\frac{d}{dx} \frac{1}{x^6} = -\frac{6}{x^7}$
 6. $\frac{d}{dx} \frac{1}{x^7} = \frac{d}{dx} x^{-7} = -7x^{-8} = -\frac{7}{x^8}$
 $\frac{d}{dx} \frac{1}{x^7} = -\frac{7}{x^8}$
 7. $\frac{d}{dx} \frac{1}{x^8} = \frac{d}{dx} x^{-8} = -8x^{-9} = -\frac{8}{x^9}$
 $\frac{d}{dx} \frac{1}{x^8} = -\frac{8}{x^9}$
 8. $\frac{d}{dx} \frac{1}{x^9} = \frac{d}{dx} x^{-9} = -9x^{-10} = -\frac{9}{x^{10}}$
 $\frac{d}{dx} \frac{1}{x^9} = -\frac{9}{x^{10}}$
 9. $\frac{d}{dx} \frac{1}{x^{10}} = \frac{d}{dx} x^{-10} = -10x^{-11} = -\frac{10}{x^{11}}$
 $\frac{d}{dx} \frac{1}{x^{10}} = -\frac{10}{x^{11}}$
 10. $\frac{d}{dx} \frac{1}{x^{11}} = \frac{d}{dx} x^{-11} = -11x^{-12} = -\frac{11}{x^{12}}$
 $\frac{d}{dx} \frac{1}{x^{11}} = -\frac{11}{x^{12}}$
 11. $\frac{d}{dx} \frac{1}{x^{12}} = \frac{d}{dx} x^{-12} = -12x^{-13} = -\frac{12}{x^{13}}$
 $\frac{d}{dx} \frac{1}{x^{12}} = -\frac{12}{x^{13}}$
 12. $\frac{d}{dx} \frac{1}{x^{13}} = \frac{d}{dx} x^{-13} = -13x^{-14} = -\frac{13}{x^{14}}$
 $\frac{d}{dx} \frac{1}{x^{13}} = -\frac{13}{x^{14}}$
 13. $\frac{d}{dx} \frac{1}{x^{14}} = \frac{d}{dx} x^{-14} = -14x^{-15} = -\frac{14}{x^{15}}$
 $\frac{d}{dx} \frac{1}{x^{14}} = -\frac{14}{x^{15}}$
 14. $\frac{d}{dx} \frac{1}{x^{15}} = \frac{d}{dx} x^{-15} = -15x^{-16} = -\frac{15}{x^{16}}$
 $\frac{d}{dx} \frac{1}{x^{15}} = -\frac{15}{x^{16}}$
 15. $\frac{d}{dx} \frac{1}{x^{16}} = \frac{d}{dx} x^{-16} = -16x^{-17} = -\frac{16}{x^{17}}$
 $\frac{d}{dx} \frac{1}{x^{16}} = -\frac{16}{x^{17}}$
 16. $\frac{d}{dx} \frac{1}{x^{17}} = \frac{d}{dx} x^{-17} = -17x^{-18} = -\frac{17}{x^{18}}$
 $\frac{d}{dx} \frac{1}{x^{17}} = -\frac{17}{x^{18}}$
 17. $\frac{d}{dx} \frac{1}{x^{18}} = \frac{d}{dx} x^{-18} = -18x^{-19} = -\frac{18}{x^{19}}$
 $\frac{d}{dx} \frac{1}{x^{18}} = -\frac{18}{x^{19}}$
 18. $\frac{d}{dx} \frac{1}{x^{19}} = \frac{d}{dx} x^{-19} = -19x^{-20} = -\frac{19}{x^{20}}$
 $\frac{d}{dx} \frac{1}{x^{19}} = -\frac{19}{x^{20}}$
 19. $\frac{d}{dx} \frac{1}{x^{20}} = \frac{d}{dx} x^{-20} = -20x^{-21} = -\frac{20}{x^{21}}$
 $\frac{d}{dx} \frac{1}{x^{20}} = -\frac{20}{x^{21}}$
 20. $\frac{d}{dx} \frac{1}{x^{21}} = \frac{d}{dx} x^{-21} = -21x^{-22} = -\frac{21}{x^{22}}$
 $\frac{d}{dx} \frac{1}{x^{21}} = -\frac{21}{x^{22}}$
 21. $\frac{d}{dx} \frac{1}{x^{22}} = \frac{d}{dx} x^{-22} = -22x^{-23} = -\frac{22}{x^{23}}$
 $\frac{d}{dx} \frac{1}{x^{22}} = -\frac{22}{x^{23}}$
 22. $\frac{d}{dx} \frac{1}{x^{23}} = \frac{d}{dx} x^{-23} = -23x^{-24} = -\frac{23}{x^{24}}$
 $\frac{d}{dx} \frac{1}{x^{23}} = -\frac{23}{x^{24}}$
 23. $\frac{d}{dx} \frac{1}{x^{24}} = \frac{d}{dx} x^{-24} = -24x^{-25} = -\frac{24}{x^{25}}$
 $\frac{d}{dx} \frac{1}{x^{24}} = -\frac{24}{x^{25}}$
 24. $\frac{d}{dx} \frac{1}{x^{25}} = \frac{d}{dx} x^{-25} = -25x^{-26} = -\frac{25}{x^{26}}$
 $\frac{d}{dx} \frac{1}{x^{25}} = -\frac{25}{x^{26}}$
 25. $\frac{d}{dx} \frac{1}{x^{26}} = \frac{d}{dx} x^{-26} = -26x^{-27} = -\frac{26}{x^{27}}$
 $\frac{d}{dx} \frac{1}{x^{26}} = -\frac{26}{x^{27}}$
 26. $\frac{d}{dx} \frac{1}{x^{27}} = \frac{d}{dx} x^{-27} = -27x^{-28} = -\frac{27}{x^{28}}$
 $\frac{d}{dx} \frac{1}{x^{27}} = -\frac{27}{x^{28}}$
 27. $\frac{d}{dx} \frac{1}{x^{28}} = \frac{d}{dx} x^{-28} = -28x^{-29} = -\frac{28}{x^{29}}$
 $\frac{d}{dx} \frac{1}{x^{28}} = -\frac{28}{x^{29}}$
 28. $\frac{d}{dx} \frac{1}{x^{29}} = \frac{d}{dx} x^{-29} = -29x^{-30} = -\frac{29}{x^{30}}$
 $\frac{d}{dx} \frac{1}{x^{29}} = -\frac{29}{x^{30}}$
 29. $\frac{d}{dx} \frac{1}{x^{30}} = \frac{d}{dx} x^{-30} = -30x^{-31} = -\frac{30}{x^{31}}$
 $\frac{d}{dx} \frac{1}{x^{30}} = -\frac{30}{x^{31}}$
 30. $\frac{d}{dx} \frac{1}{x^{31}} = \frac{d}{dx} x^{-31} = -31x^{-32} = -\frac{31}{x^{32}}$
 $\frac{d}{dx} \frac{1}{x^{31}} = -\frac{31}{x^{32}}$
 31. $\frac{d}{dx} \frac{1}{x^{32}} = \frac{d}{dx} x^{-32} = -32x^{-33} = -\frac{32}{x^{33}}$
 $\frac{d}{dx} \frac{1}{x^{32}} = -\frac{32}{x^{33}}$
 32. $\frac{d}{dx} \frac{1}{x^{33}} = \frac{d}{dx} x^{-33} = -33x^{-34} = -\frac{33}{x^{34}}$
 $\frac{d}{dx} \frac{1}{x^{33}} = -\frac{33}{x^{34}}$
 33. $\frac{d}{dx} \frac{1}{x^{34}} = \frac{d}{dx} x^{-34} = -34x^{-35} = -\frac{34}{x^{35}}$
 $\frac{d}{dx} \frac{1}{x^{34}} = -\frac{34}{x^{35}}$
 34. $\frac{d}{dx} \frac{1}{x^{35}} = \frac{d}{dx} x^{-35} = -35x^{-36} = -\frac{35}{x^{36}}$
 $\frac{d}{dx} \frac{1}{x^{35}} = -\frac{35}{x^{36}}$
 35. $\frac{d}{dx} \frac{1}{x^{36}} = \frac{d}{dx} x^{-36} = -36x^{-37} = -\frac{36}{x^{37}}$
 $\frac{d}{dx} \frac{1}{x^{36}} = -\frac{36}{x^{37}}$
 36. $\frac{d}{dx} \frac{1}{x^{37}} = \frac{d}{dx} x^{-37} = -37x^{-38} = -\frac{37}{x^{38}}$
 $\frac{d}{dx} \frac{1}{x^{37}} = -\frac{37}{x^{38}}$
 37. $\frac{d}{dx} \frac{1}{x^{38}} = \frac{d}{dx} x^{-38} = -38x^{-39} = -\frac{38}{x^{39}}$
 $\frac{d}{dx} \frac{1}{x^{38}} = -\frac{38}{x^{39}}$
 38. $\frac{d}{dx} \frac{1}{x^{39}} = \frac{d}{dx} x^{-39} = -39x^{-40} = -\frac{39}{x^{40}}$
 $\frac{d}{dx} \frac{1}{x^{39}} = -\frac{39}{x^{40}}$
 39. $\frac{d}{dx} \frac{1}{x^{40}} = \frac{d}{dx} x^{-40} = -40x^{-41} = -\frac{40}{x^{41}}$
 $\frac{d}{dx} \frac{1}{x^{40}} = -\frac{40}{x^{41}}$
 40. $\frac{d}{dx} \frac{1}{x^{41}} = \frac{d}{dx} x^{-41} = -41x^{-42} = -\frac{41}{x^{42}}$
 $\frac{d}{dx} \frac{1}{x^{41}} = -\frac{41}{x^{42}}$
 41. $\frac{d}{dx} \frac{1}{x^{42}} = \frac{d}{dx} x^{-42} = -42x^{-43} = -\frac{42}{x^{43}}$
 $\frac{d}{dx} \frac{1}{x^{42}} = -\frac{42}{x^{43}}$
 42. $\frac{d}{dx} \frac{1}{x^{43}} = \$

12.2.2

1. $HA \rightleftharpoons H^+ + A^-$ K_a
 2. $H_2O \rightleftharpoons H^+ + OH^-$ K_w
 3. $H_2O + A^- \rightleftharpoons HA + OH^-$ K_b
 4. $H_2O + H^+ \rightleftharpoons H_3O^+$ K_h
 5. $H_2O + OH^- \rightleftharpoons OH_2^-$ K_{oh}
 6. $H_2O + H_2O \rightleftharpoons H_3O^+ + OH^-$ K_{auto}
 7. $H_2O + H_2O \rightleftharpoons H_5O_2^+$ K_{h_2}
 8. $H_2O + H_2O \rightleftharpoons H_2O_2$ K_{h_3}
 9. $H_2O + H_2O \rightleftharpoons H_2O_2 + H_2$ K_{h_4}
 10. $H_2O + H_2O \rightleftharpoons H_2O_2 + H_2O_2$ K_{h_5}
 11. $H_2O + H_2O \rightleftharpoons H_2O_2 + H_2O_2 + H_2O_2$ K_{h_6}
 12. $H_2O + H_2O \rightleftharpoons H_2O_2 + H_2O_2 + H_2O_2 + H_2O_2$ K_{h_7}
 13. $H_2O + H_2O \rightleftharpoons H_2O_2 + H_2O_2 + H_2O_2 + H_2O_2 + H_2O_2$ K_{h_8}
 14. $H_2O + H_2O \rightleftharpoons H_2O_2 + H_2O_2 + H_2O_2 + H_2O_2 + H_2O_2 + H_2O_2$ K_{h_9}
 15. $H_2O + H_2O \rightleftharpoons H_2O_2 + H_2O_2 + H_2O_2 + H_2O_2 + H_2O_2 + H_2O_2 + H_2O_2$ $K_{h_{10}}$



[illegible]



$R_1 I_1 R_2 I_2 R_3 I_3 R_4 I_4$

14.2.1

$R_1 R_2 R_3 \dots I_1 I_2 I_3 \dots$

צריך להחליף את המיקום של R ושל I במקום

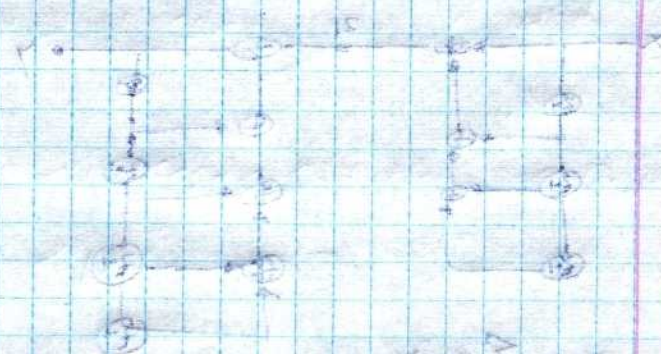


לפי זה נראה כי יש להחליף את המיקום של R ושל I במקום

המיקום של R ושל I :

$A_0 B_0 C_0 D_0 E_0 F_0$

$A B a b C \dots d E F e f$



$\max(X) = 10$

