

10. Tutorium : Zeitdiskrete Signale

Zeitdiskrete Signale : Folgen einheitloser Zahlenwerte

Beispiel : $U[n] = \{ \dots, U[-2], U[-1], U[0], U[1], U[2], \dots \}$

Mittelwert : $M_u[n_1, n_2] = \frac{1}{n_2 - n_1 + 1} \sum_{n=n_1}^{n_2} u[n]$

Energie : $W_u[n_1, n_2] = \sum_{n=n_1}^{n_2} u^2[n]$

Leistung : $P_u[n_1, n_2] = \frac{1}{n_2 - n_1 + 1} \sum_{n=n_1}^{n_2} u^2[n]$

Varianz : $\sigma_u^2[n_1, n_2] = P_u[n_1, n_2] - M_u^2[n_1, n_2]$

Korrelation

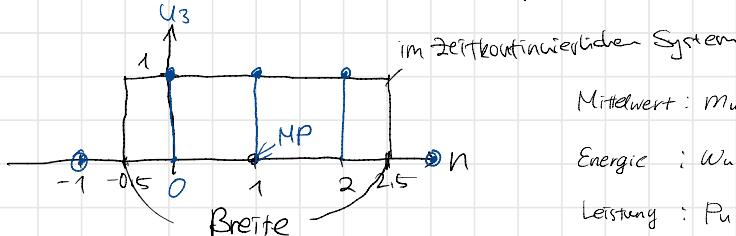
$$r_{uv}[k] = \sum_{n=-\infty}^{\infty} u[n] v[n+k]$$

Faltung

$$U[n] * V[n] = \sum_{k=-\infty}^{\infty} u[k] v[n-k]$$

$$Q.1 \quad c) [\text{HA}]: u_3(n) = \tau_{\text{Breite}}^n \underset{\substack{\text{Mittelpkt} \\ \tau_{\text{Breite}}}}{\square}_3(n-1)$$

ges.: Mittelwert, Energie, Leistung und Varianz im Bereich $0 \leq n \leq 5$



im zeitkontinuierlichen System

$$\text{Mittelwert: } M_u[n_1, n_2] = \frac{1}{n_2 - n_1 + 1} \sum_{n=n_1}^{n_2} u[n]$$

$$\text{Energie: } W_u[n_1, n_2] = \sum_{n=n_1}^{n_2} u^2[n]$$

$$\text{Leistung: } P_u[n_1, n_2] = \frac{1}{n_2 - n_1 + 1} \sum_{n=n_1}^{n_2} u^2[n]$$

$$\text{Varianz: } \sigma_u^2[n_1, n_2] = P_u[n_1, n_2] - M_u^2[n_1, n_2]$$

$$M_{u_3}[0, 5] = \frac{1}{5-0+1} \sum_{n=0}^5 u_3[n] = \frac{1}{6} \cdot \{1+1+1+0+0+0\} = \frac{1}{2}$$

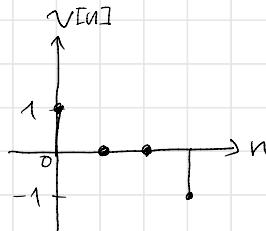
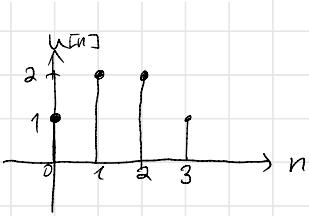
$$W_{u_3}[0, 5] = \sum_{n=0}^5 u_3^2[n] = 1^2 + 1^2 + 1^2 + 0^2 + 0^2 + 0^2 = 3$$

$$P_{u_3}[0, 5] = \frac{1}{6} \cdot 3 = \frac{1}{2}$$

$$\sigma_{u_3}^2[0, 5] = \frac{1}{2} - \left(\frac{1}{2}\right)^2 = \frac{1}{4}$$

3. 1

b) [HA]: $u = \{1, 2, 2, 1\}$, $v = \{1, 0, 0, -1\}$



Korrelation

Papierstreifenmethode

	1	2	2	1	
				1	0 0 -1
				1 0	0 -1
				1 0 0	-1
				1 0 0 -1	
	1	0	0	-1	
1	0	0	-1		

$$u = \{1, 2, 2, 1\}$$

$$v = \{1, 0, 0, -1\}$$

$$r_{uv}[k] = \left\{ \begin{array}{l} 1, 2, 2, 0, -2, -2, -1 \\ k=-3 \quad k=2 \quad k=1 \quad k=0 \quad k=1 \quad k=2 \quad k=3 \end{array} \right\}$$

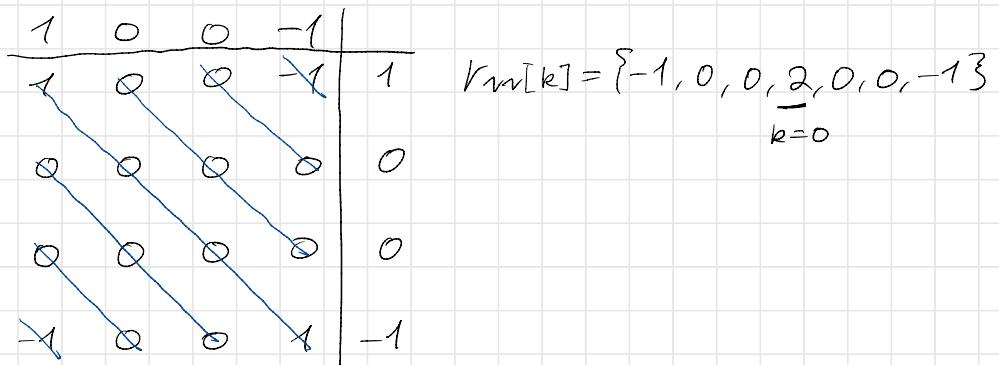
Faltungsmethode für RRF

	1	2	2	1	
	1	2	2	1	1
	0	0	0	0	0
	0	0	0	0	0
	-1	-2	-2	-1	-1

$$r_{uv}[k] = \left\{ \begin{array}{l} 1, 2, 2, 0, -2, -2, -1 \\ k=0 \end{array} \right\}$$

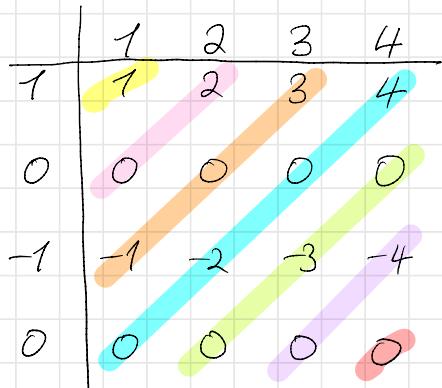
Autokorrelation r_{nn}

$$N = \{1, 0, 0, -1\}$$



4.1 Bestimme Faltung und zyklische Faltung der Signale $u = \{1, 2, 3, 4\}$
und $v = \{1, 0, -1, 0\}$.

Faltung



$$u * v [k] = \underbrace{\{1, 2, 2, 2, -3, -4, 0\}}_{k=0}^{3-1 \quad 4-2}$$

Zyklische Faltung

			1	2	3	4	
0	-1	0	1	0	-1	0	1
0	-1	0	1	0	-1	0	1
0	-1	0	1	0	-1	0	1
0	-1	0	1	0	-1	0	1

zykl.
 $u * v [k] = \underbrace{\{-2, -2, 2, 2\}}_{k=0}$