Lösungen zu den 1. Tests
Signale und Systeme 2, Sommersemester 2006

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1. Beispiel:

Gruppe A

a) $h[n] = \delta[n] + \frac{1}{2}\,\delta[n-1]$, Skizze trivial.

b) $a[n] = \sum_{k=-\infty}^{n} h[k] = \sigma[n] + \frac{1}{2}\,\sigma[n-1]$, Skizze trivial.

c) $y[n] = x[n] + \frac{1}{2}\,x[n-1] = \ldots = \frac{1}{2}\left(1 + \sum_{k=-\infty}^{\infty} \delta[n+2k]\right)$.

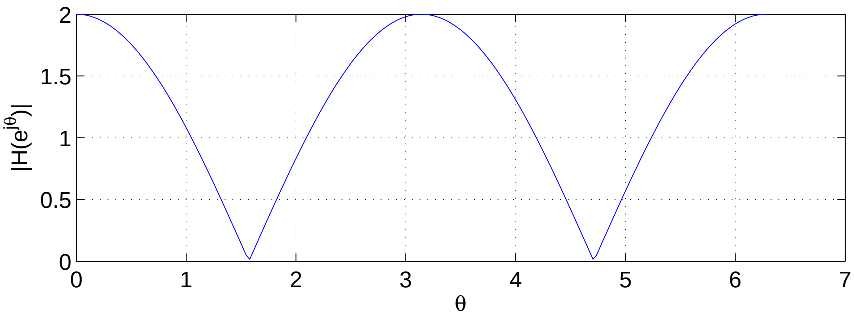
d) $N_x = 2,\ c_k = \frac{1}{2}\sum_{n=0}^{1} \delta[n] e^{-j\pi kn} = \frac{1}{2}, \quad k = 0, 1.$

e) $N_y = 2,\ d_k = \frac{1}{2}\sum_{n=0}^{1}\left(\delta[n] + \frac{1}{2}\,\delta[n-1]\right) e^{-j\pi kn} = \begin{cases} \frac{3}{4} & k = 0 \\ \frac{1}{4} & k = 1 \end{cases}$

oder direkt aus c): $d_k = \frac{1}{2}(\delta[k] + c_k)$.

Gruppe B

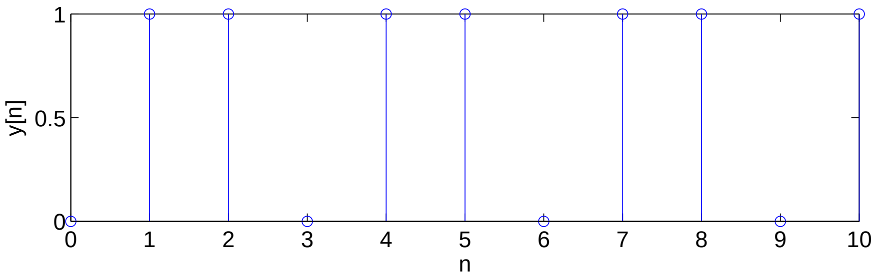
a) $H(e^{j\theta}) = e^{-j\theta} + e^{j\theta} = 2\cos\theta$



b) $a[n] = \sum_{k=-\infty}^{n} h[k] = \sigma[n-1] + \sigma[n+1]$, Skizze trivial.

c) $x[n] = \sum_{k=-\infty}^{\infty} \delta[n+3k]$

$$y[n] = x[n-1] + x[n+1] = \ldots = 1 - \sum_{k=-\infty}^{\infty} \delta[n+3k]$$



d) $N_x = 3,\ c_k = \frac{1}{3}\sum_{n=0}^{2}\delta[n]e^{-j\frac{2\pi}{3}kn} = \frac{1}{3}, \quad k = 0, 1, 2.$

e) $N_y = 3$, aus $y[n] = 1 - x[n]$ folgt wegen Linearität $d_k = \delta[k] - c_k = \begin{cases} \frac{2}{3} & k = 0 \\ -\frac{1}{3} & k = 1, 2 \end{cases}.$

2. Beispiel:

Gruppe A

a) $y[n] = FT^{-1}\left\{H(e^{j\theta})X(e^{j\theta})\right\} = 2\,\delta[n+1] + \frac{1}{4}\,\delta[n-2]$, Skizze trivial.

Formelsammlung: $e^{\pm j\theta} \Longleftrightarrow \delta[n \pm 1]$ und $\frac{1}{1 - \frac{1}{2e^{j\theta}}} \Longleftrightarrow \left(\frac{1}{2}\right)^n \sigma[n]$.

b) $y[n] = (x * h)[n] = 2\,\delta[n+1] + \frac{1}{4}\,\delta[n-2]$
mit $h[n] = 2\,\delta[n+1] - \frac{1}{2}\,\delta[n-1]$ und $x[n] = \left(\frac{1}{2}\right)^n \sigma[n] - \frac{1}{2}\,\delta[n-1]$.

Gruppe B

a) $y[n] = \frac{1}{2}\,\delta[n-1] + \frac{1}{4}\,\delta[n-2]$, Skizze trivial.

b) $H(e^{j\theta}) = 1 - \frac{1}{4}\,e^{-j2\theta},\ \ X(e^{j\theta}) = -1 + \frac{1}{1 - \frac{1}{2}\,e^{-j\theta}},$

$y[n] = FT^{-1}\left\{H(e^{j\theta})X(e^{j\theta})\right\} = \frac{1}{2}\,\delta[n-1] + \frac{1}{4}\,\delta[n-2].$

3. Beispiel:

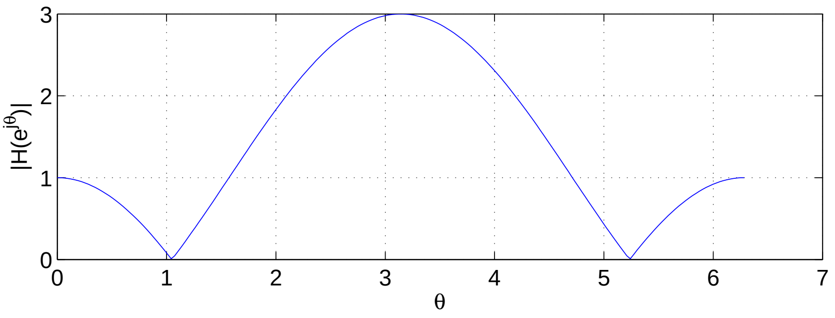
Gruppe A

a) stabil, da Impulsantwort absolut summierbar ist $\sum_{n=-\infty}^{\infty} |h[n]| < \infty.$

b) akausal, da $h[n] \neq 0,\ n < 0.$

c) $h[n] = -\delta[n-1] + \delta[n] - \delta[n+1]$, Skizze trivial.

d) $H(e^{j\theta}) = -e^{-j\theta} + 1 - e^{j\theta} = 1 - 2\cos\theta.$



Gruppe B

a) stabil, da Impulsantwort absolut summierbar ist $\sum_{n=-\infty}^{\infty} |h[n]| < \infty$.

b) akausal, da $h[n] \neq 0,\ n < 0$.

c) $h[n] = \frac{1}{2}\,\delta[n+2] + \delta[n+1] + \frac{1}{2}\,\delta[n]$, Skizze trivial.

d) $H(e^{j\theta}) = \frac{1}{2}e^{j2\theta} + e^{j\theta} + \frac{1}{2} = e^{j\theta}\,(1+\cos\theta)$.