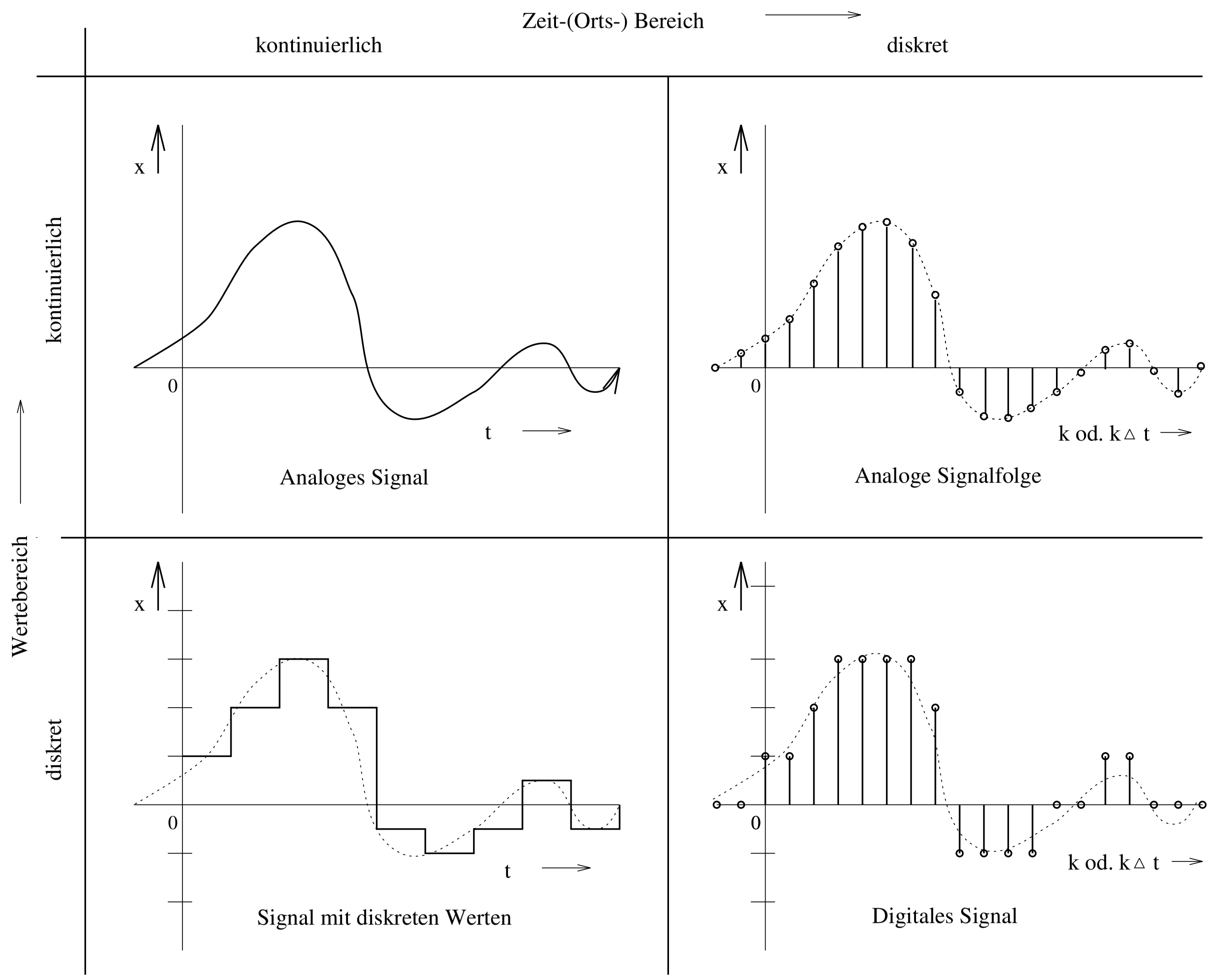
Seminar-Praktikum: “Communications 1”

Seminarversuch 2:

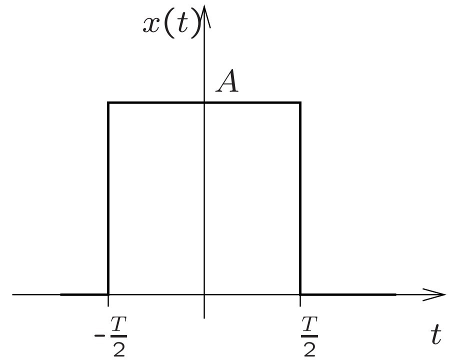
“Signalparameter im Zeit- und Frequenzbereich”

Stand: 30.10.2008

1. Zeit- und Werteigenschaften von Signalen
2. Prinzip der Abtastung und Quantisierung analoger Signale



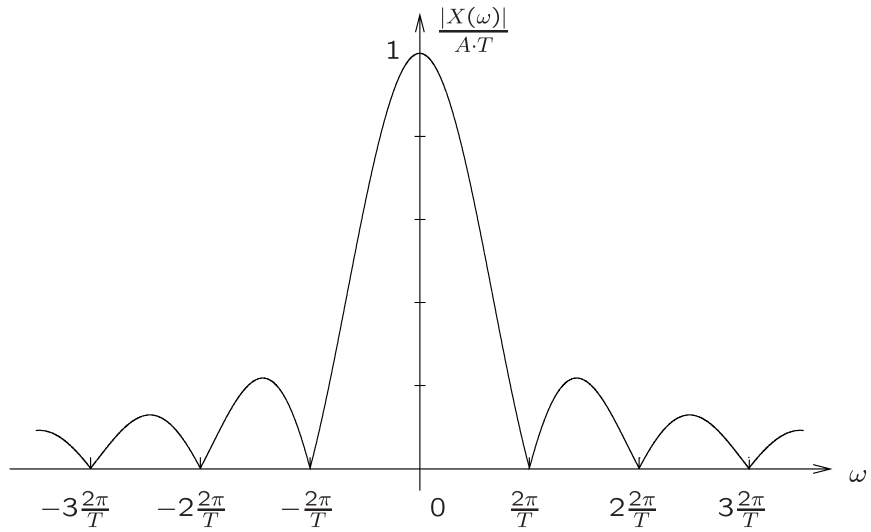
Zeit- und Werteigenschaften von Signalen

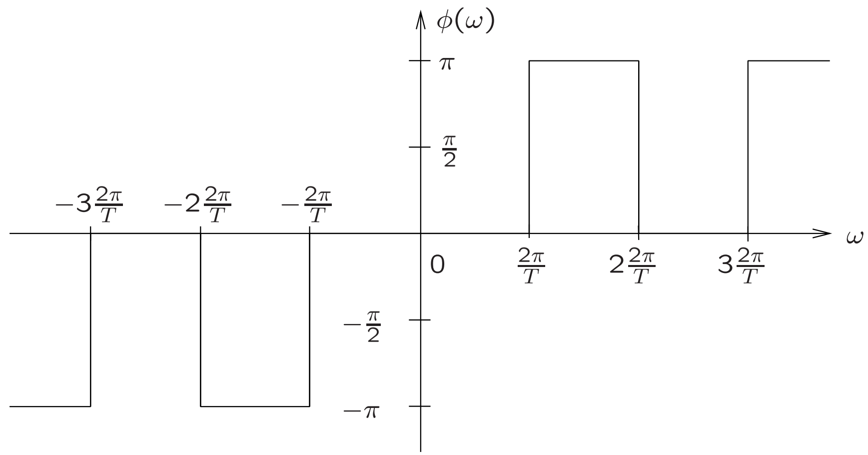


$$x_{\mathrm{p}}(t) \;=\; \sum_{n=-\infty}^{\infty} x(t-nT_0), \quad \text{wobei} \quad T \leq T_0$$

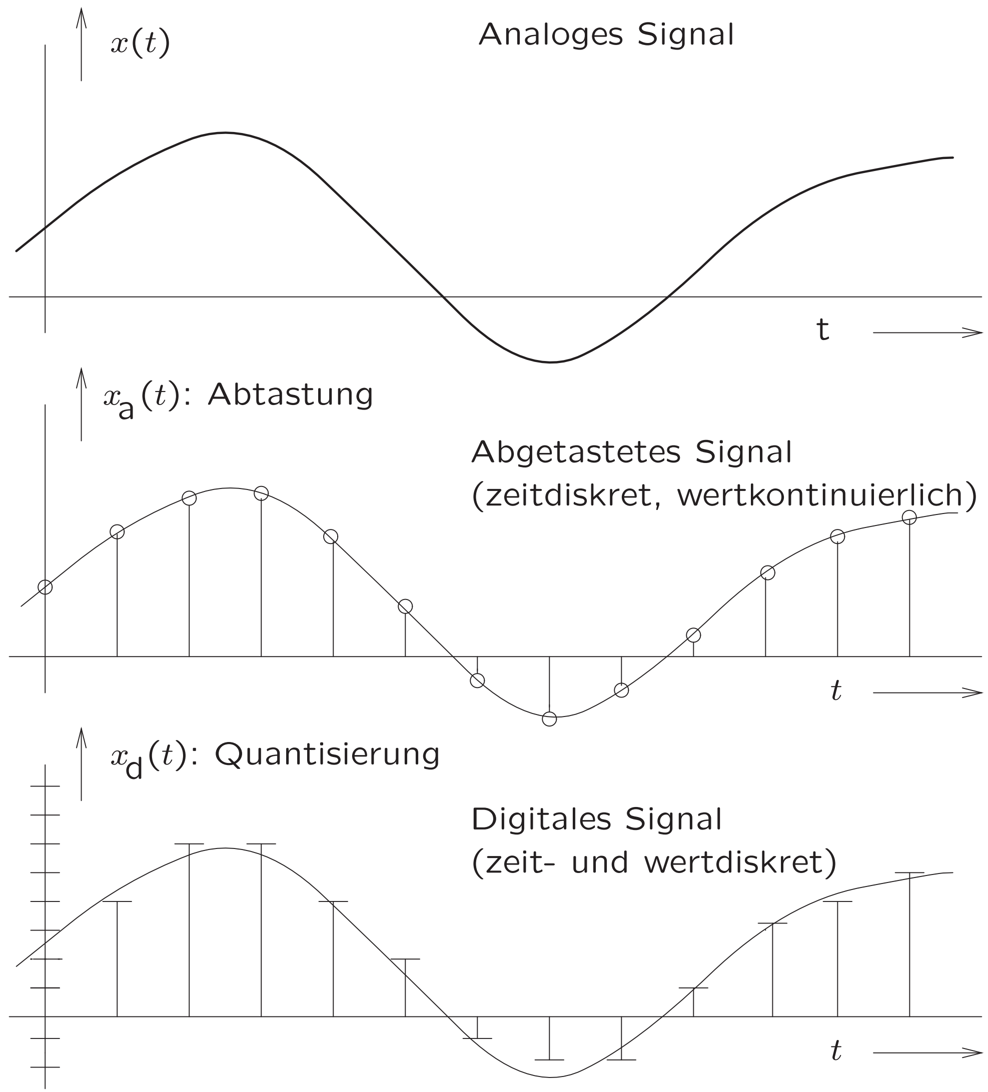
$$\;=\; \sum_{n=-\infty}^{+\infty} \underline{c}_n \mathrm{e}^{\mathrm{j}n\omega_0 t} \quad \text{mit } \underline{c}_n = \frac{1}{T_0} \int_{\frac{T_0}{2}}^{\frac{T_0}{2}} x(t)\mathrm{e}^{-\mathrm{j}n\omega_0 t}\mathrm{d}t, \quad \omega_0 = \frac{2\pi}{T_0}$$

$$X(\omega) \;=\; \int_{-\infty}^{+\infty} x(t)\,\mathrm{e}^{-\mathrm{j}\omega t}\mathrm{d}t = \int_{-\frac{T_0}{2}}^{+\frac{T_0}{2}} x(t)\,\mathrm{e}^{-\mathrm{j}\omega t}\mathrm{d}t$$

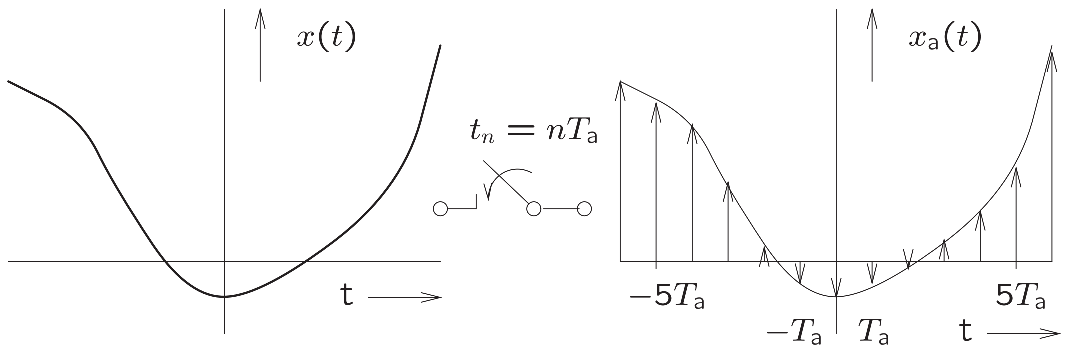


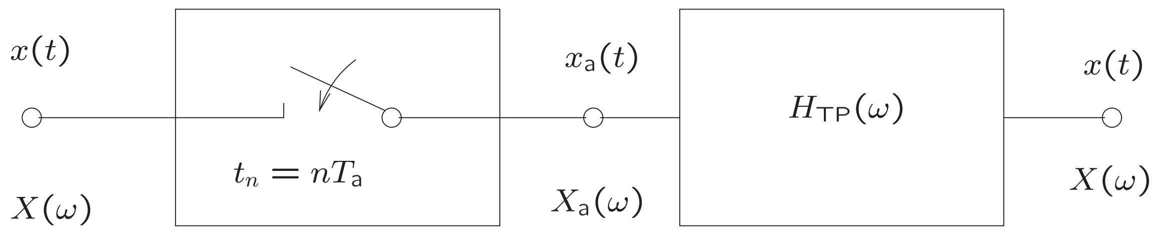


Betrags- und Phasenspektrum der Funktion $x(t)$



$x(t)$
Analoges Signal
t
$x_a(t)$: Abtastung
Abgetastetes Signal
(zeitdiskret, wertkontinuierlich)
t
$x_d(t)$: Quantisierung
Digitales Signal
(zeit- und wertdiskret)
t

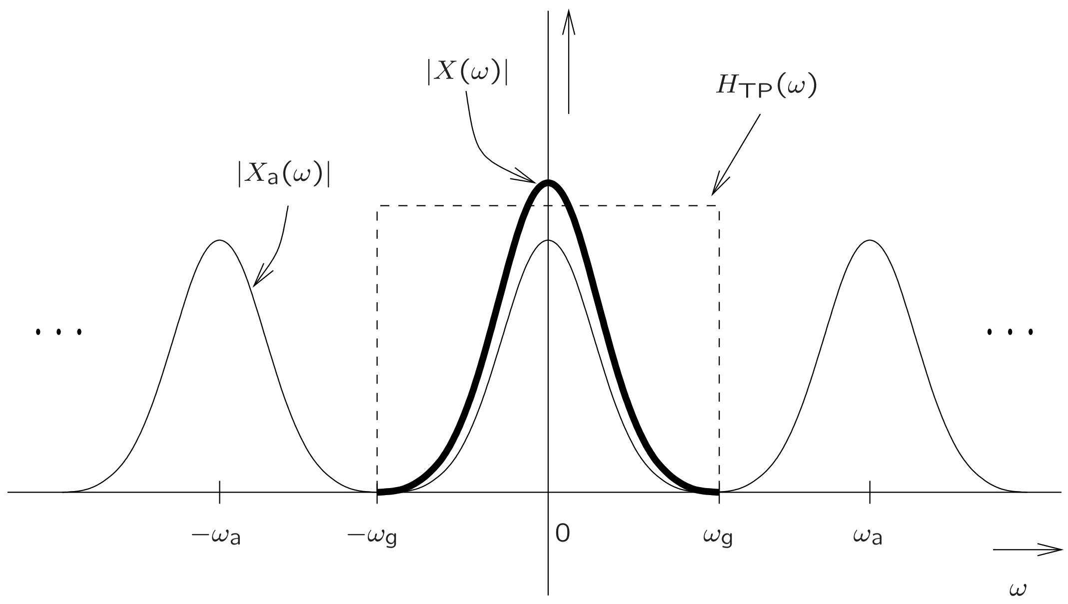

$x(t)$
t
$t_n = nT_a$
$x_a(t)$
$-5T_a$
$5T_a$
$-T_a$
T_a
t



$$x_{\mathrm{a}}(t) = x(t) \cdot \sum_{n=-\infty}^{\infty} \delta(t - nT_{\mathrm{a}}) = \sum_{n=-\infty}^{\infty} x(nT_{\mathrm{a}})\, \delta(t - nT_{\mathrm{a}})$$

$$X_{\mathrm{a}}(\omega) = \frac{1}{T_{\mathrm{a}}} \cdot X(\omega) * \sum_{n=-\infty}^{\infty} \delta(\omega - n\omega_{\mathrm{a}})$$

$$H_{\mathrm{TP}}(\omega) = \begin{cases} T_{\mathrm{a}} & |\omega| \leq \omega_{\mathrm{g}} \\ 0 & \text{sonst} \end{cases},$$



Spektralfunktion bei Abtastung mit der Nyquistrate