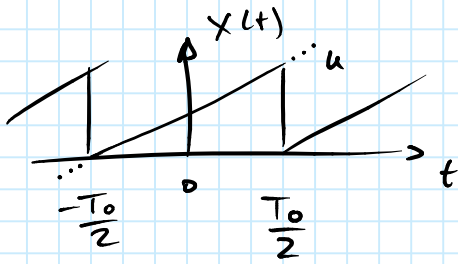


# Beispiel: Fourierreihen, Sägezahn



$$x(t) \text{ innerhalb Periode} = t \cdot \frac{u}{T_0} + \frac{u}{2}$$

$$C_h = \frac{1}{T_0} \int_{T_0} x(t) e^{-j\omega_0 h t} dt = \frac{1}{T_0} \int_{-\frac{T_0}{2}}^{+\frac{T_0}{2}} t \cdot \frac{u}{T_0} e^{-j\omega_0 h t} dt + \frac{1}{T_0} \int_{-\frac{T_0}{2}}^{+\frac{T_0}{2}} \frac{u}{2} e^{-j\omega_0 h t} dt =$$

$$I = \frac{u}{T_0^2} \left( -\frac{t}{j\omega_0 h} + \frac{1}{\omega_0^2 h^2} \right) e^{-j\omega_0 h t} \Big|_{T_0} = \frac{1}{(-j)^2} = +j^2 = -1$$

$$= \frac{u}{T_0^2} \left( -\frac{T_0^2}{4j\pi h} + \frac{T_0^2}{4\pi^2 h^2} \right) e^{-j\pi h} - \frac{u}{T_0^2} \left( \frac{T_0^2}{4j\pi h} + \frac{T_0^2}{4\pi^2 h^2} \right) e^{j\pi h} =$$

$$= u \left( \underbrace{-\frac{1}{4j\pi h} e^{-j\pi h} - \frac{1}{4j\pi h} e^{j\pi h}}_{-\frac{\cos(\pi h)}{2j\pi h}} + \underbrace{\frac{1}{4\pi^2 h^2} e^{-j\pi h} - \frac{1}{4\pi^2 h^2} e^{j\pi h}}_{-\frac{j\sin(\pi h)}{2\pi^2 h^2}} \right)$$

$$-\frac{\cos(\pi h)}{2j\pi h} \quad -\frac{j\sin(\pi h)}{2\pi^2 h^2}$$

$$II = \frac{u}{2T_0} \cdot \frac{e^{-j\omega_0 h t}}{-j\omega_0 h} = \frac{u}{2T_0} \left( -\frac{e^{-j\pi t}}{j\omega_0 h} + \frac{e^{+j\pi t}}{j\omega_0 h} \right) =$$

$$= \frac{u \cdot 2j}{2T_0 j\omega_0 h} \sin(\pi h) = \frac{u}{2\pi h} \sin(\pi h)$$

$$C_h = \left( \frac{u}{2\pi h} - \frac{uj}{2\pi^2 h^2} \right) \sin(\pi h) - \frac{u}{2j\pi h} \cos(\pi h)$$

$$2j \cdot \sin(x) = e^{ix} - e^{-ix}$$

$$2 \cdot \cos(x) = e^{ix} + e^{-ix}$$