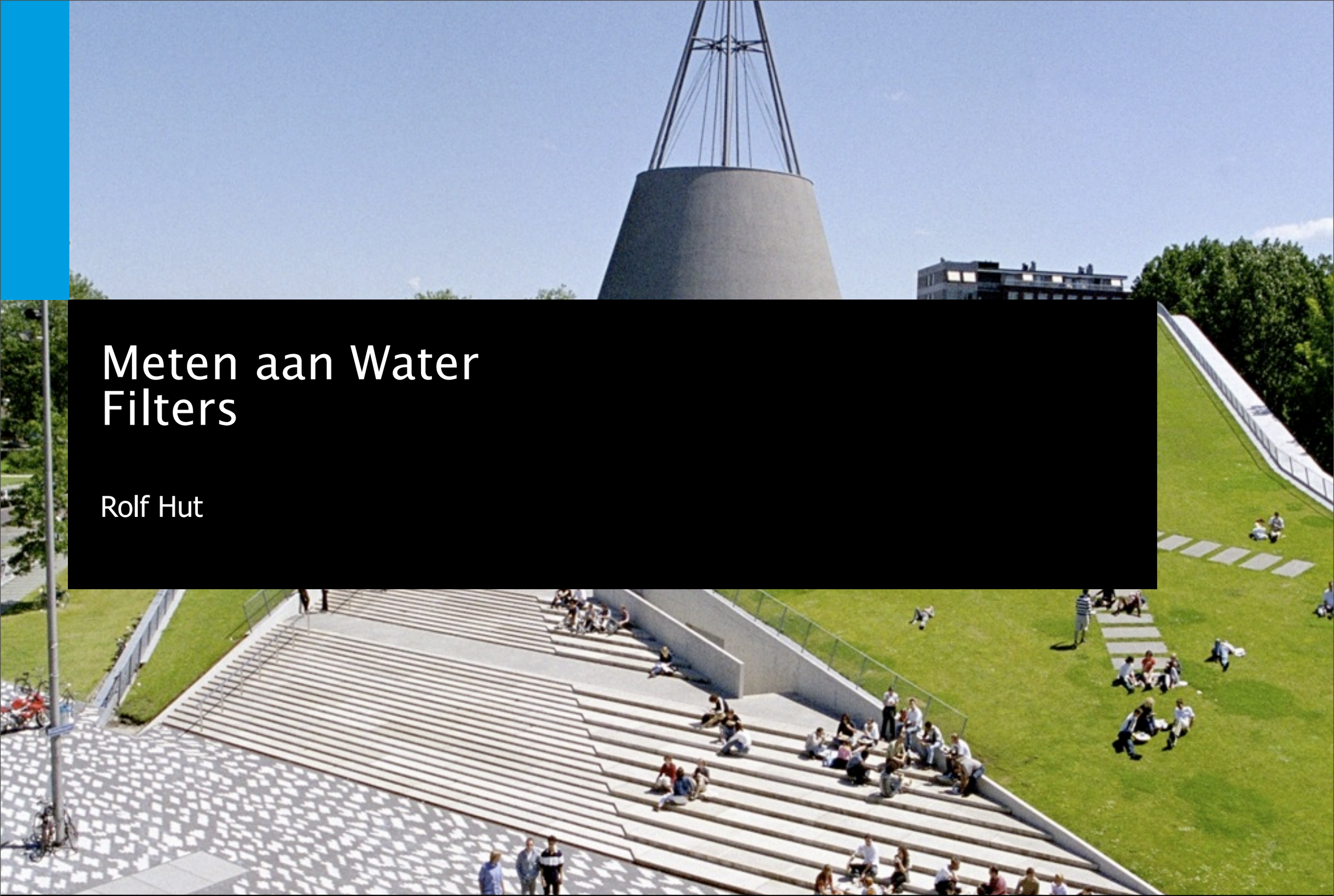
Measurements for water

Rolf Hut

Meten aan water: filters

Meten aan Water Filters

Rolf Hut



TU Delft
Delft University of Technology

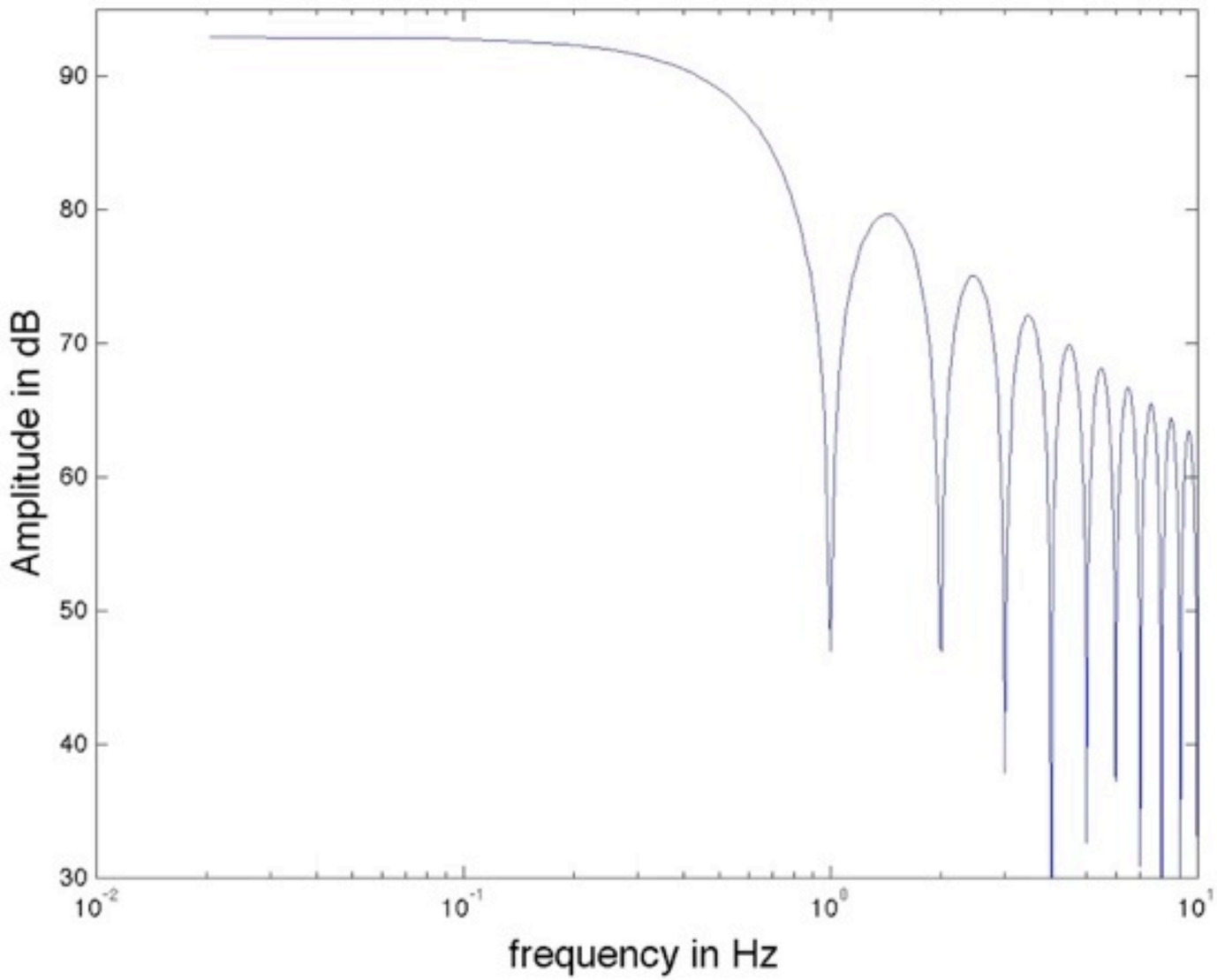
Challenge the future

Filters

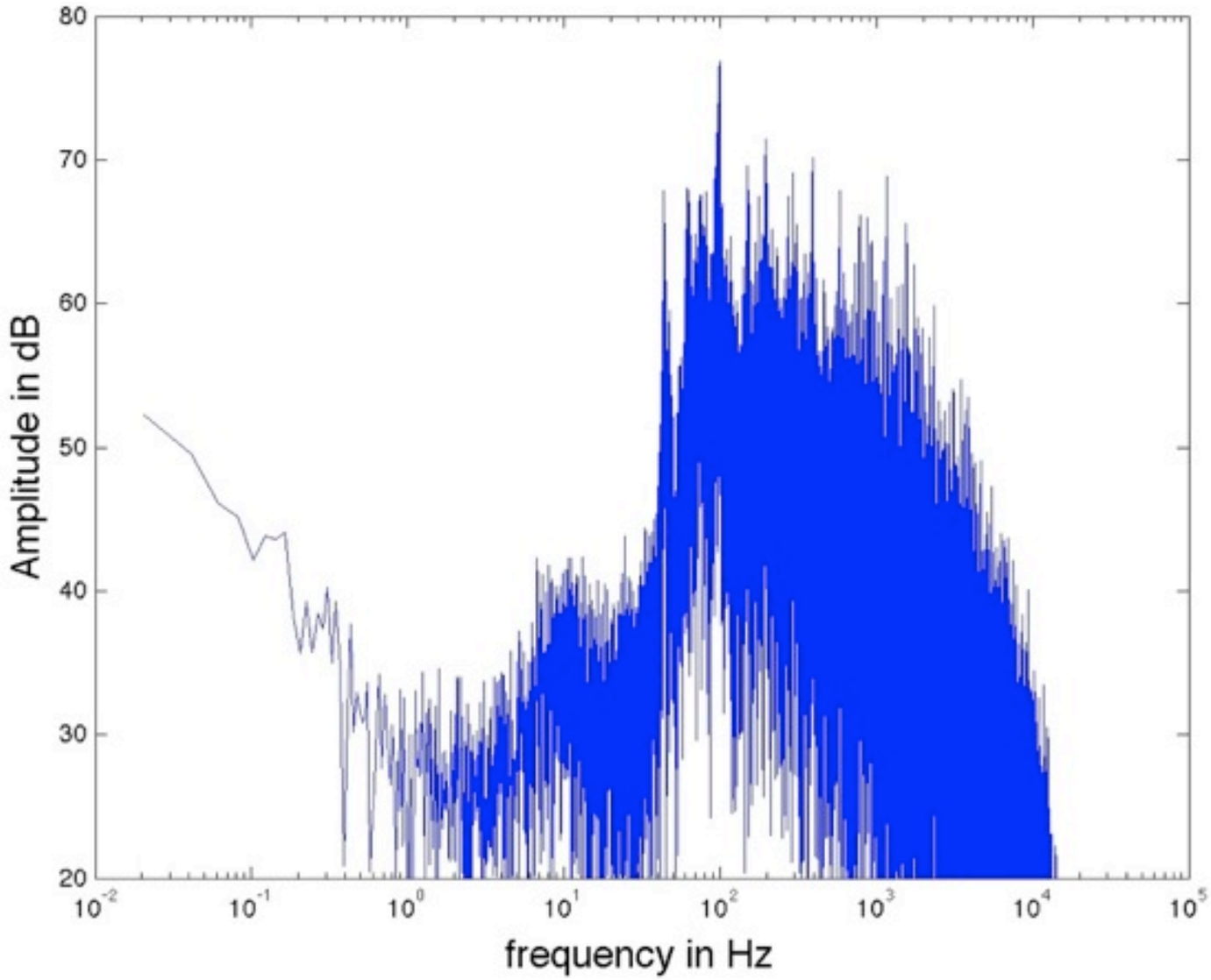
$$g(t) = \int_{-\infty}^{\infty} f(\tau)\, h(t-\tau)\, d\tau \leftrightarrow G(i\omega) = F(i\omega)\, H(i\omega)$$

$$h(t) = \begin{cases} 1, & 0 < t < t_0 \\ 0, & \text{else} \end{cases}$$

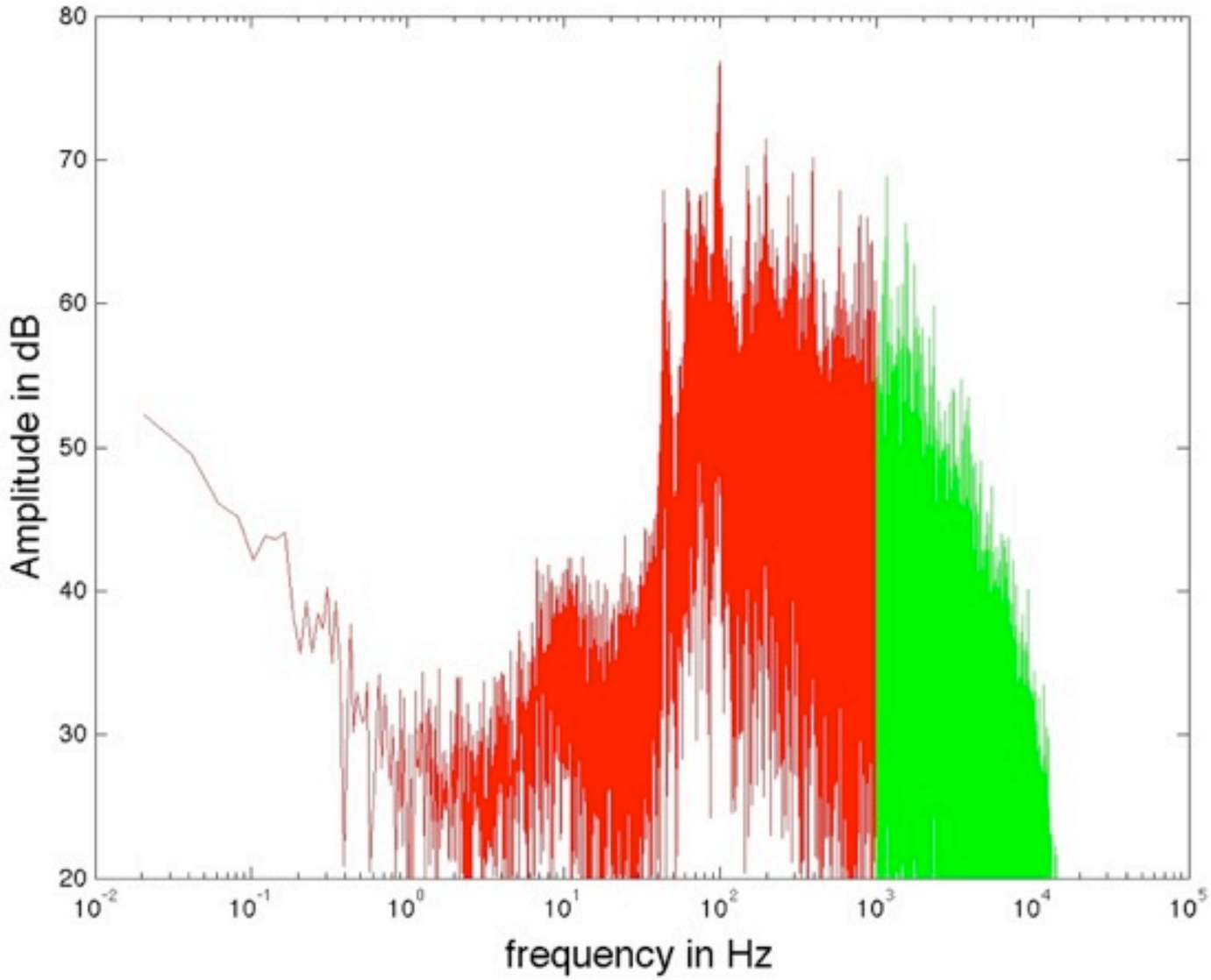
Filters


90
80
70
60
50
40
30
Amplitude in dB
10^{-2}
10^{-1}
10^{0}
10^{1}
frequency in Hz

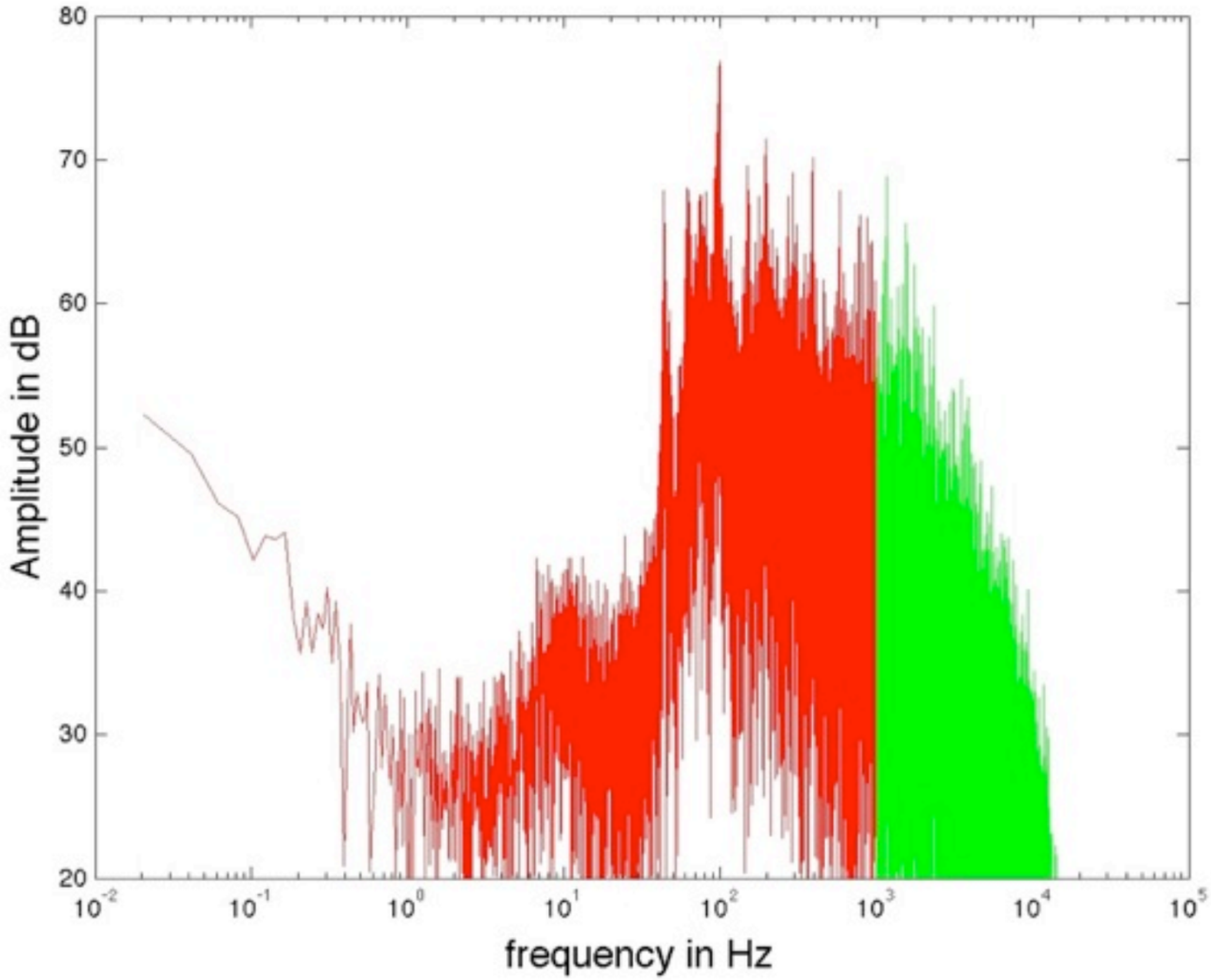
Filters: ideal low pass



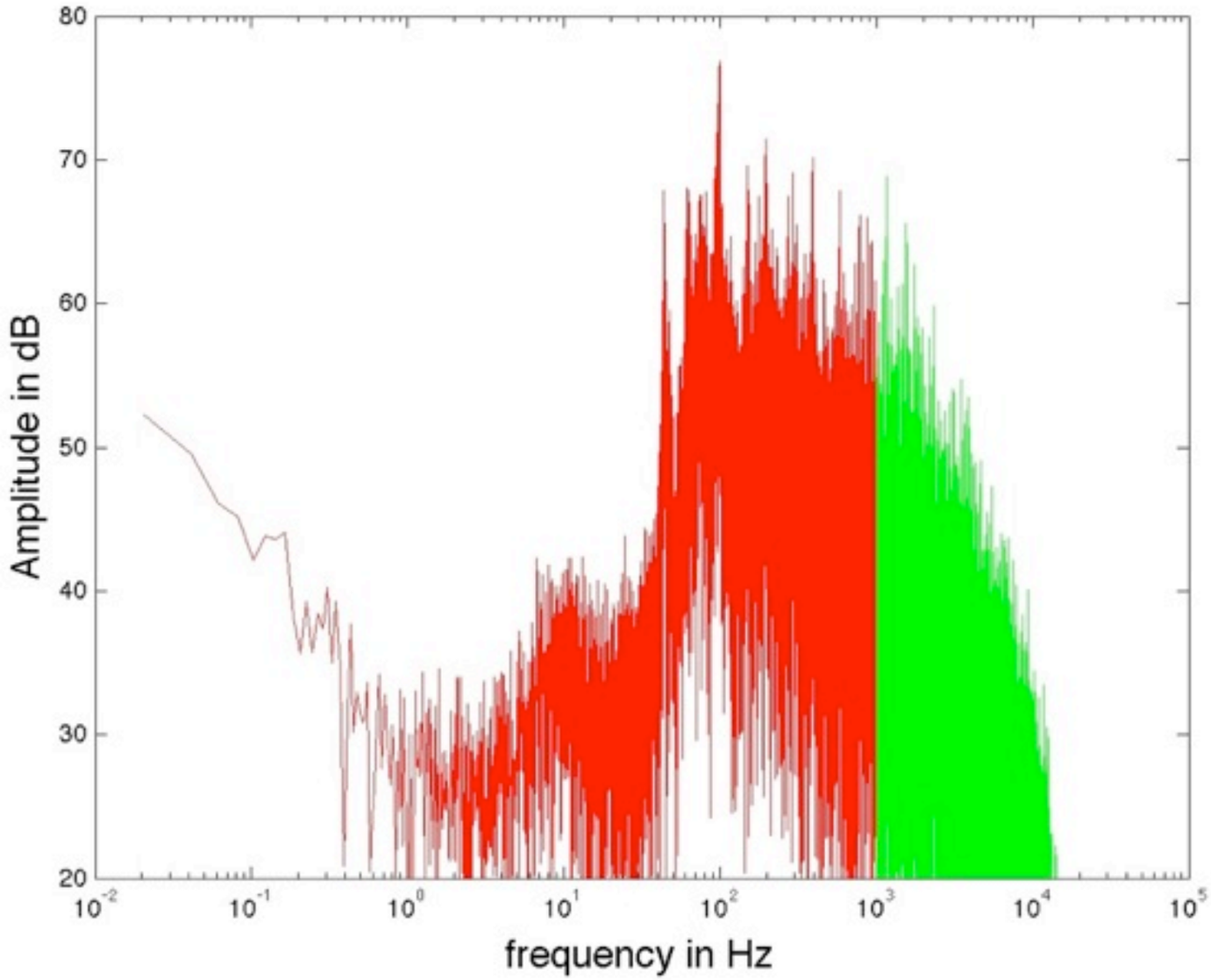
Filters: ideal low pass



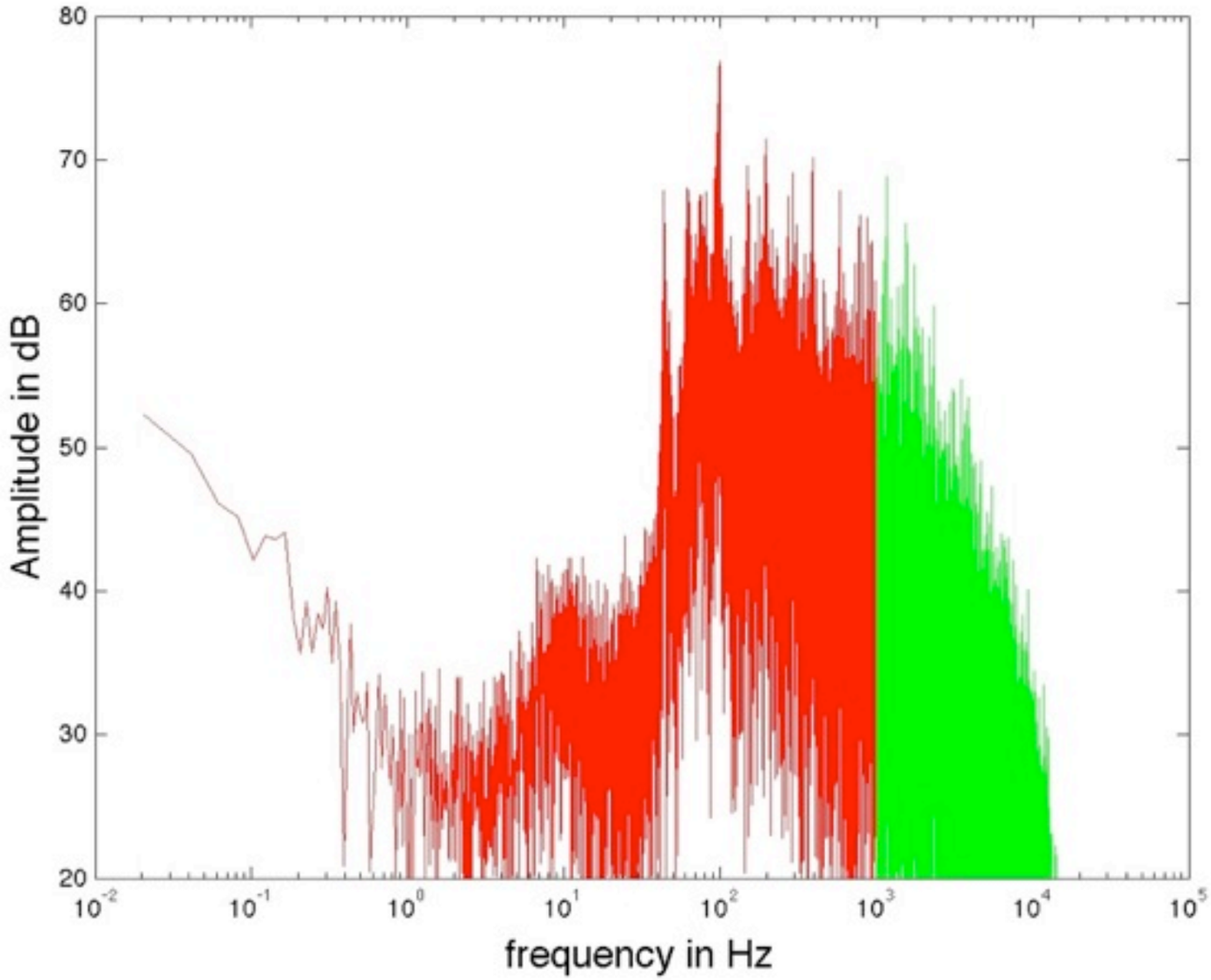
Filters: ideal low pass



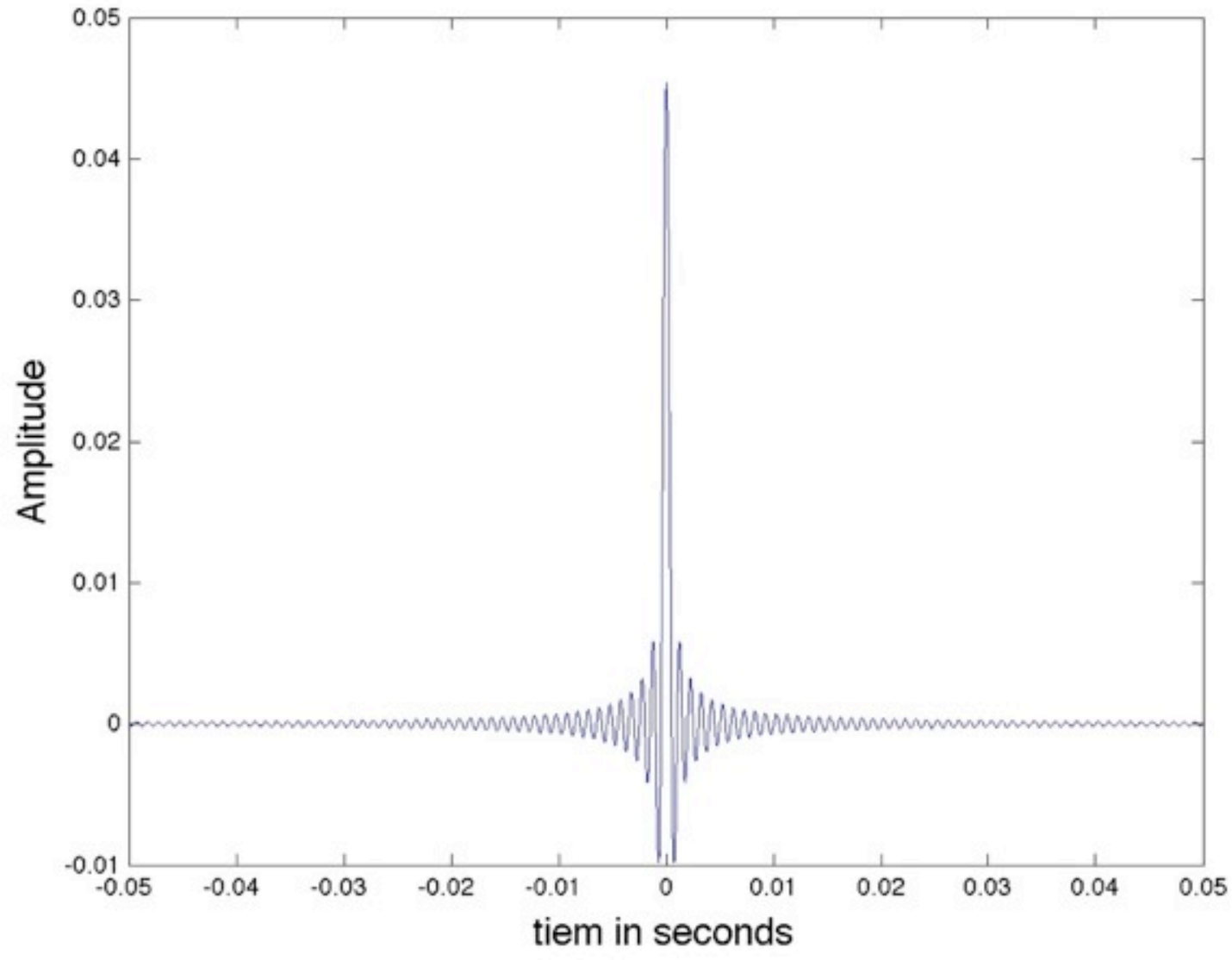
Filters: ideal low pass



Filters: ideal low pass



Filters ideal low pass



Fourier transformatie

- Differentiate

$$g(t) = \frac{d}{dt} f(t) \leftrightarrow G(i\omega) = i\omega F(i\omega)$$

- RC network, Low pass filter!

$$H(i\omega) = \frac{1}{1 + RCi\omega}$$

Filter = Systeem

- mass spring system

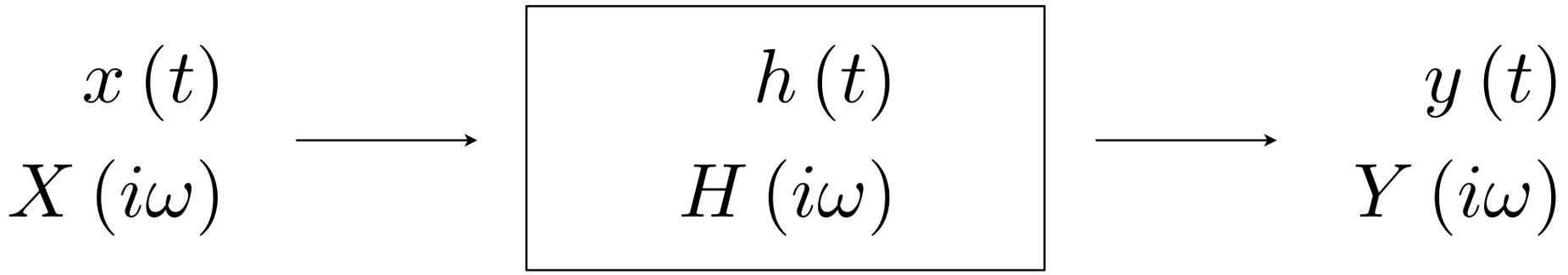
$$m\frac{d^2y\left(t\right)}{dt^2} = x\left(t\right) - ky\left(t\right) - b\frac{dy\left(t\right)}{dt}$$

$$\omega_n = \sqrt{\frac{k}{m}}$$

$$\xi = \frac{b}{2\sqrt{km}}$$

$$H\left(i\omega\right) = \frac{1}{\left(\frac{i\omega}{\omega_n}\right)^2 + 2\xi\left(\frac{i\omega}{\omega_n}\right) + 1}$$

Filter = Systeem



input LTI Systeem output

$$y(t) = \int_{-\infty}^{\infty} x(\tau)\, h(t-\tau)\, d\tau$$

$$Y(i\omega) = X(i\omega)\, H(i\omega)$$