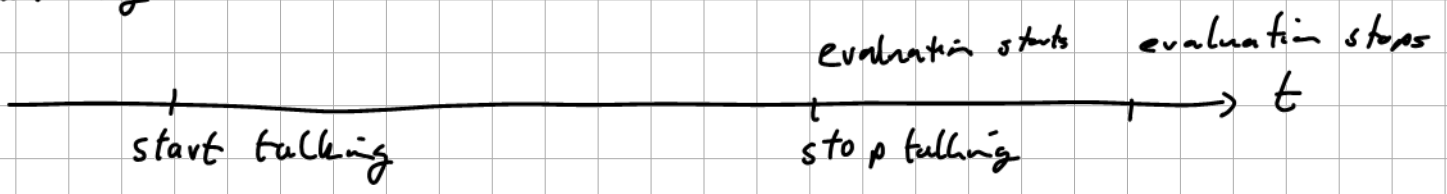
Latency



Let's go to the supermarket.

→ result as a string is available

J1, C2, EP1

$r = 44100 \frac{\text{Samples}}{s}$ stereo

$w = 16 \frac{\text{Bit}}{\text{Sample}}$

duration $t = 70$ minutes

number of Bits?

$2 \cdot 70 \text{ minutes} \cdot 44100 \frac{\text{Samples}}{s} \cdot 16 \frac{\text{Bit}}{\text{Sample}} \cdot 60 \frac{s}{\text{minute}}$

$= 5.927 \cdot 10^9$ Bits

J1, C2, EP2

$L = 20 \cdot \log_{10} \frac{p_{eff}}{20 \mu Pa}$

$p_{eff} = p_{RMS} = 0.0\underbrace{707}_{\text{3 digits}} \text{ Pa}$

$L = 20 \cdot \log_{10} \frac{0.0707 \text{ Pa}}{20 \mu Pa} = 71.0 \text{ dB SPL}$

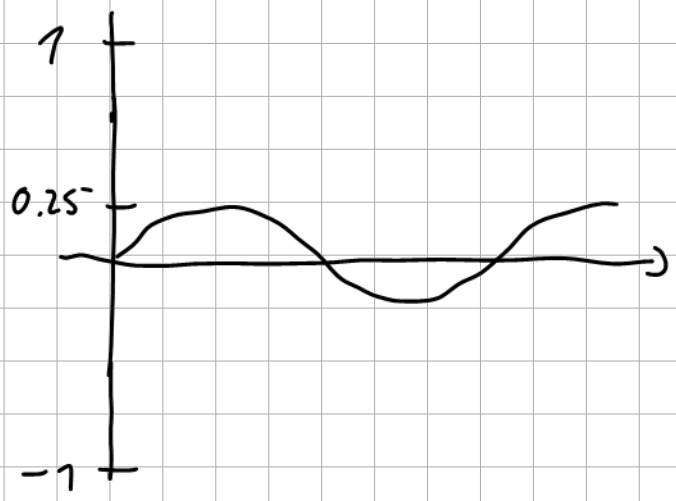
$x_{(n)} = 0.25 \quad \sin\left(2\pi f \frac{1}{r}\right)$

$|?| = 1.0$

dB FS ?

scaling factor $a = ?$

$$dB\ FS = 10 \log_{10} \frac{2P}{|?|^2}$$



$P = ?$

$$RMS = \frac{0.25}{\sqrt{2}}$$

$$P = RMS^2 = \frac{0.25^2}{2}$$

$$dB\ FS = 10 \log_{10} \frac{2 \cdot \frac{0.25^2}{2}}{1.0^2} = -12.0 \quad dB\ FS$$

scaling factor a?

$$a = dB\ FS - dB\ SPL$$

$$= -12 - 71 = -83$$

Power of discrete vector $x_{(n)}$:

$$x_{(n)} = [0, 1, 2, 3, 4]$$

$$P = \frac{1}{5}(0 + 1 + 4 + 9 + 16)$$

$$= \frac{1}{5}\ 30 = 6$$

J1 , Ch2, EP 3

-12 dB FS $\quad w = 16 \quad A = 1.0$

SNR of this quantisation noise?

$$10 \log_{10} \frac{\sum x_{(n)}^2}{\sum (x_{(n)} - y_{(n)})^2}$$

$$10 \log_{10} \frac{\frac{1}{N} \sum x_{(n)}^2}{P_E}$$

$$P_E = \frac{\Delta^2}{12} \qquad \Delta = \frac{2A}{2^w} = \frac{2}{2^{16}}$$

$$= \frac{\left(\frac{2}{2^{16}}\right)}{12} = \frac{\frac{4}{2^{32}}}{12} = 7.76 \cdot 10^{-11}$$

$$-12 \text{ dB FS} = 10 \cdot \log_{10} \frac{2P}{A^2}$$

$$10^{\left(\frac{-12}{10}\right)} = \frac{2P}{A^2}$$

$$\frac{10^{-\frac{12}{10}}}{2} \cdot \frac{A^2}{w} = P = 0.0315$$

$$SNR = 10 \cdot \log_{10} \frac{0.0315}{7.76 \cdot 10^{-11}} = 86.1 \text{ dB}$$

21, Ch 2, EP 4

$x(t) = a \cdot \cos(2\pi f t)$ 75 dB SPL $f = 2$ kHz

$a = ?$ RMS

f doesn't matter

$$20 \log_{10} \frac{p_{eff}}{20\,\mu Pa} = 75$$

$f > 0$ Hz:

$RMS = \frac{a}{\sqrt{2}}$

$f = 0$ Hz

$RMS = a$

$$p_{eff} = \frac{a}{\sqrt{2}}$$

$$75 = 20 \log_{10} \frac{\frac{a}{\sqrt{2}}}{20\,\mu Pa}$$

$$10^{\left(\frac{75}{20}\right)} = \frac{\frac{a}{\sqrt{2}}}{20\,\mu Pa}$$

$$20\,\mu Pa \cdot \sqrt{2} \cdot 10^{\left(\frac{75}{20}\right)} = a = 0.159\ Pa$$

Sign of a cannot be determined, because RMS has no sign information.

22, Ch 2, EP 1

$n = 0, 1, 2$

$h(n) = [1, 2, 1]$ $v = 1$

z-transform, high, low, band?

$$H(z) = \sum_{n=-\infty}^{\infty} h(n) \cdot z^{-n}$$

$$= 1 \cdot z^{-0} + 2 \cdot z^{-1} + 1 \cdot z^{-2}$$

$$= 1 + 2z^{-1} + z^{-2} \qquad z \to e^{j2\pi f T}$$

$$H(f) = 1 + 2e^{-j2\pi f} + e^{-j4\pi f} \qquad = e^{j2\pi f \frac{1}{r}}$$

$$\xi = \sqrt{(1 + 2\cos(2\pi f) + \cos(4\pi f))^2 + (-2\sin(2\pi f) - \sin(4\pi f))^2}$$

$$= e^{-j2\pi f}\left(e^{j2\pi f} + 2 + e^{-j2\pi f}\right)$$

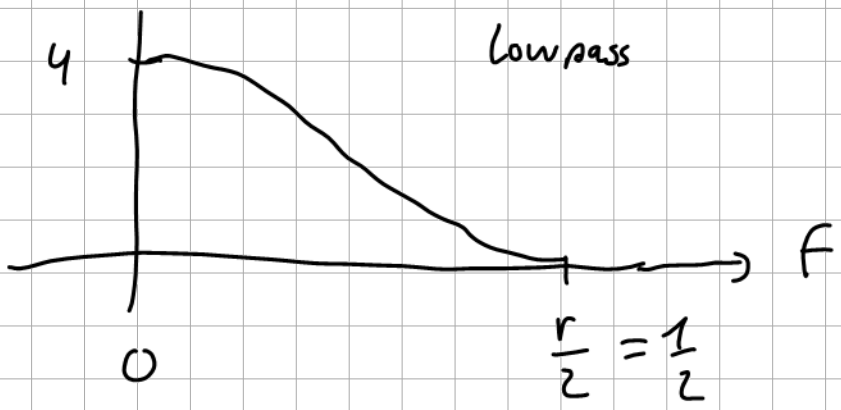
$$|H(f)| = \sqrt{(\cos(2\pi f) + 2 + \cos(2\pi f))^2 + (\sin(2\pi f) - \sin(2\pi f))^2}$$

$$= \sqrt{(2\cos(2\pi f) + 2)^2}$$

$$\xi = \sqrt{4\cos^2(2\pi f) + 8\cos(2\pi f) + 4}$$

$$= |2\cos(2\pi f) + 2|$$

$$= 2\cos(2\pi f) + 2$$



12 CH2 EP6

$\sum_n (a\, y(n-T) - z(n))^2$ minimizieren bezüglich a

$\sum_n a^2 y^2(n-T) - 2a\, y(n-T)\, z(n) + z^2(n)$

$$\frac{d}{da} = 2a \sum_n y^2(n-\bar{i}) - 2 \sum_n y(n-\bar{i})\, z(n) = 0$$

$$a \sum_n y^2(n-\bar{i}) = \sum_n y(n-\bar{i})\, z(n)$$

$$a = \frac{\sum_n y(n-\bar{i})\, z(n)}{\sum_n y^2(n-\bar{i})}$$