IIR Test

Goal To design and implement a LPF in order to remove high frequency noise from live audio. Self implementing the circular buffer and IIR filter.

The biquad transfer function defined as

$$H(z) = \frac{b_0 + b_1 z^-1 + b_2 z^-2}{a_0 + a_1 z^-1 + a_2 z^-2} = \frac{\frac{b_0}{a_0} + \frac{b_1}{a_0} z^-1 + \frac{b_2}{a_0} z^-2}{1 + \frac{a_1}{a_0} z^-1 + \frac{a_2}{a_0} z^-2}$$

Implementation using Direct form I

$$\begin{aligned} \implies y[n] = \frac{b_0}{a_0} x[n] + \frac{b_1}{a_0} x[n-1] + \frac{b_2}{a_0} x[n-2] \\ - \frac{a_1}{a_0} y[n-1] - \frac{a_2}{a_0} y[n-2] \end{aligned}$$

User defined parameters

Parameter	Value	Description
F_s	44.1 kHz	sampling frequency
f_0	8 kHz - 12 kHz (variable)	significant frequency
Q	0.707	quality factor

Intermediate variables

$$\omega_0 = 2\pi \frac{f_0}{F_s}$$
$$\cos\omega_0 \quad , \quad \sin\omega_0$$
$$\alpha = \frac{\sin\omega_0}{2Q}$$

Compute the coeffiecients for the LPF

$$\begin{aligned} b_0 &= \frac{1 - \cos\omega_0}{2} \\ b_1 &= 1 - \cos\omega_0 \\ b_2 &= \frac{1 - \cos\omega_0}{2} \\ a_0 &= 1 + \alpha \\ a_1 &= -2\cos\omega_0 \\ a_2 &= 1 - \alpha \end{aligned}$$