	<p align="center"><i>Project</i></p> <p align="center">Digital Signal Processors</p> <p align="center"><i>Prof. Dr.-Ing. Franz Quint</i></p>	DSP
	<p>Karlsruhe University of Applied Sciences</p>	EIT - Telecommunications

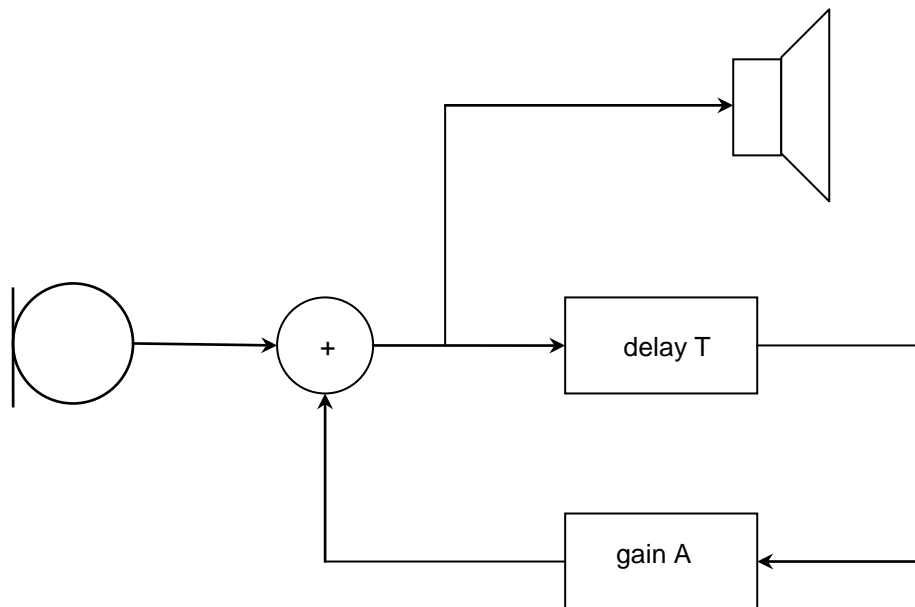
Audio effects: Reverb and flanger

Write a program that is reading a signal from the microphone or line-in input, optionally adds a reverb (repeated echo) or flanger effect, and outputs the signal on the line-out output.

Boundary conditions for reverberation:

- The reverb effect occurs due to a IIR-filter with the difference equation.: $y[k] = x[k] + \alpha y[k-N]$. The parameter α is the gain, while N is the delay.
- The delay should be adjustable between $T_{min} = 0 \text{ s}$ and $T_{max} = 1 \text{ s}$, the gain between $A_{min} = -60 \text{ dB}$ und $A_{max} = 0 \text{ dB}$.

Algorithm:



Requirements for flanger:

The Flanger-effect is caused by a comb filter with the difference equation:


$$y[k] = x[k] + \alpha x[k-N]$$

The frequency response of the comb filter has a cosine shape with zeros at distance $\frac{f_a}{N}$. The parameter α determines the strength of the filter, the filter effect, and thus the strength of the flanger effect. The flanger effect is caused by the fact that the length N of the filter within the period T of the flanger effect is changed linearly from a minimum to a maximum value and back again.

- The length N of the comb filter should accept values for which the zeros of the comb filter are located in intervals of between 50 Hz and 1 kHz. The parameter α takes values between -1 and 1. The period T of the effect should be between 1 s and 10 s adjustable.

General requirements:

- The processing should be done blockwise in double buffer mode. i.e.: the sample values are read via a serial interface of the EDMA and stored in the input-ping-buffer. At the same time, the CPU processes the data from the input-pong-buffer and writes the result to the output-pong-buffer. The EDMA outputs the data from the output ping buffer through the serial interface. When the buffer is processed, the roles of ping- and pong- buffer are switched. This change is indicated to the CPU via an interrupt by EDMA. The CPU expects to be in stock and afterwards falls asleep.

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- In the HWI routines takes place the switch and the handover of the buffers. The actual processing takes place in SWI routines.
- The processing shall be able to handle stereo signals.
- The parameters should be adjustable over GEL scripts from the surface of the CCS.
- Display via LEDs the selected operating mode.

Program the algorithm in Matlab.

Create a block diagram for your program, according to the required activities and functions.

Modularize your program.

Think of a clever distribution of activities on the processor. Set the interfaces.

Consider a test concept for your program in order to test the functionality of the submodules during development.

Think about the proof of the overall functionality of the program.