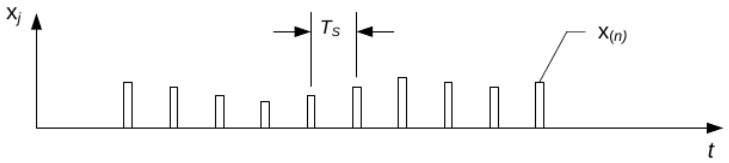
Task

A. Write a procedure for a first-order exponential filter that allows for noise reduction in the input signal.



$$y(n) = \alpha \cdot x_{(n)} + (1 - \alpha) \cdot y_{(n-1)}$$

The advantage of the exponential filter is the ability to adjust the level of noise reduction by changing the smoothing coefficient α $(0 < \alpha < 1)$. The smaller the α , the greater the noise reduction, but the slower the filter responds to changes in the input signal.

B. Assess the correctness of the filter's operation using the schemes shown below (Fig. 3).

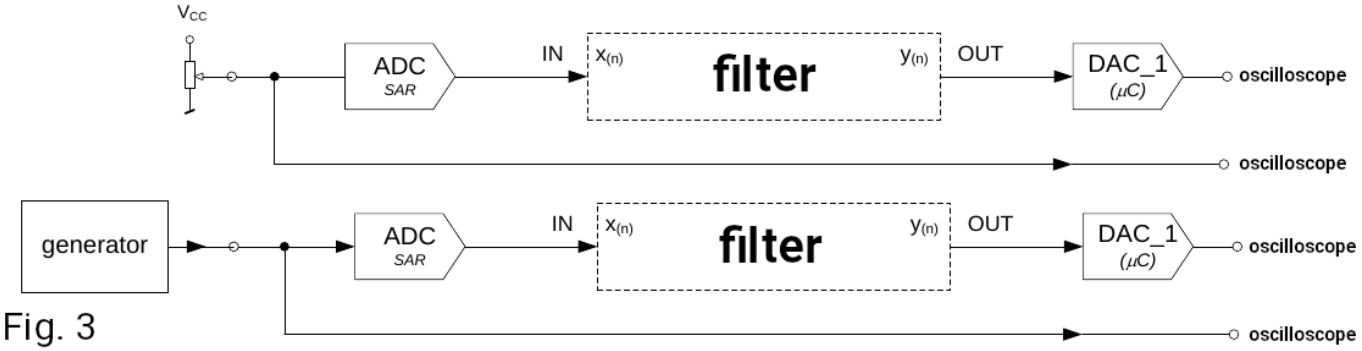


Fig. 3

C. Investigate the filter's impulse and step response using the scheme shown below (Fig. 4). This requires writing a program to generate unit impulses and steps.

Fig. 4

Notes

- the samples are stored in RAM – ensure no conflict with the area occupied by the *stack*
- suggested number of samples in the window – a power of 2
- for calculating the filter's output signal, consider the possibility of exceeding the processor's word width

Grading

- tasks **A**+**B**: maximum 40 points
- tasks **A**+**B**+**C**: maximum 50 points

Suggested Literature

R.G. Lyons, "Introduction to Digital Signal Processing," WKŁ.