

Calculation of fo Coefficient

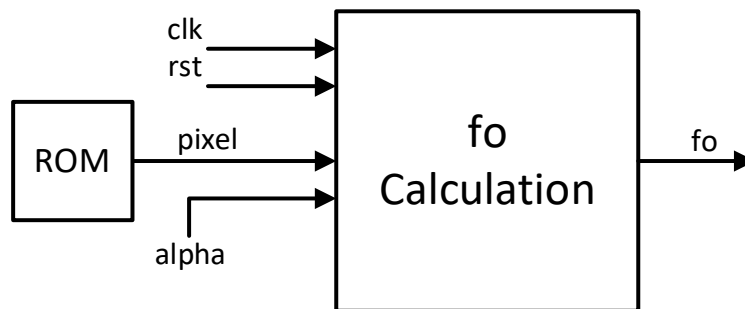
In an image elaboration system, it is necessary to calculate the fo coefficient:

$$fo = \alpha \cdot y(i-1, j) + (1 - \alpha) \cdot y(i, j)$$

where:

- $y(i-1, j)$ and $y(i, j)$ are pixels of the matrix y , which represents an image. $y(i) \in I, y(i) \in [0, 255]$.
- α is a parameter chosen by the user. $\alpha \in (0, 1)$

It is required to design a digital circuit for implementing such operation. 10-bits are sufficient to represent α in 7.3 fixed-point arithmetic. The output fo is represented in $N.3$ fixed-point arithmetic, where N must be chosen accordingly to the dynamic of the output (to be studied). The interface of the circuit to be designed is as follows:



Pixels' values are read from a ROM containing all matrix elements. Only one pixel per cycle can be read from the ROM. The fo calculation circuit must autonomously read the pixels from memory to provide the output.

You are requested to deal with the various possible error situations, documenting the choices made. In particular, it is necessary to take into consideration:

- Pixel order in ROM
- Values of pixels and alpha out of specifications

The final project report must contain:

- Introduction (circuit description, possible applications, possible architectures, etc.)
- Description of the architecture designed (block diagram, inputs/outputs, etc.)
- VHDL code (with detailed comments) to be attached to the report.
- Test strategy (Test-plan) and related Testbench for verification; a detailed, though not exhaustive, verification is required, including error situations and borderline cases of functioning
- Interpretation of the results obtained in the automatic synthesis/implementation on a Xilinx FPGA platform in terms of maximum clock frequency (critical path), elements used (slice, LUT, etc.) and estimated power consumption. Comment on any warning messages.
- Conclusions