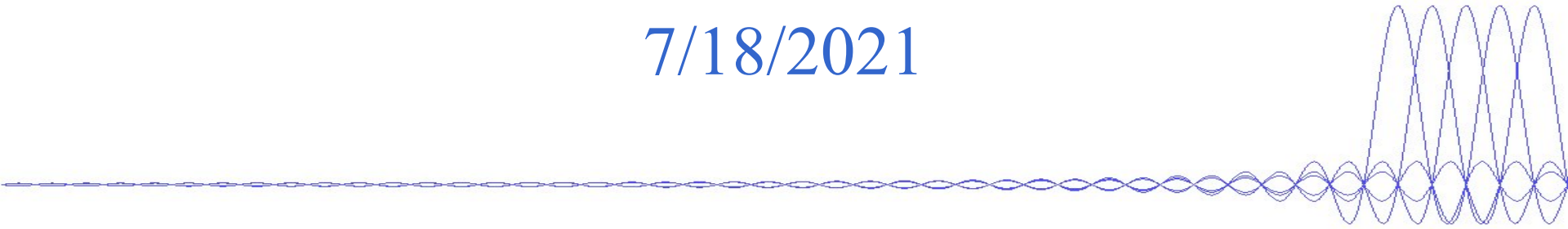
COMPUTER ENGINEERING

UIT
TRƯỜNG ĐẠI HỌC
CÔNG NGHỆ THÔNG TIN

DIGITAL SYSTEM DESIGN WITH HDL

FINAL PROJECT
Median Filter Algorithm

7/18/2021



COMPUTER ENGINEERING

Median Filter Overview

- The median filter is a non-linear digital filtering technique, often used to remove noise from an image or signal.

- Median filtering is very widely used in digital image processing because, under certain conditions, it preserves edges while removing noise :

Use of a median filter to improve an image severely corrupted by defective pixels

COMPUTER ENGINEERING

Median Filter Overview

- Definition :

  - Given the sequence x1, x2,,.. xn monotonous with increasing (or decreasing) sequence. Then the median of the series of symbols Med({xn}) is defined:

    + If n odd Med = x[(n/2) + 1]

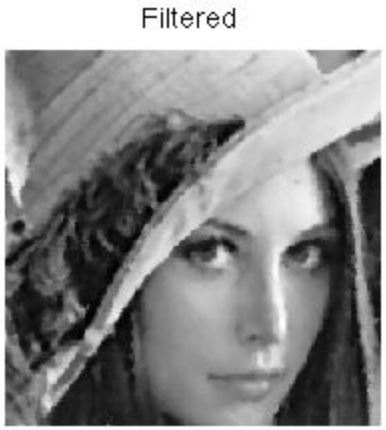
    +If n is even: Med = x[n/2] or Med = x[(n/2) + 1]

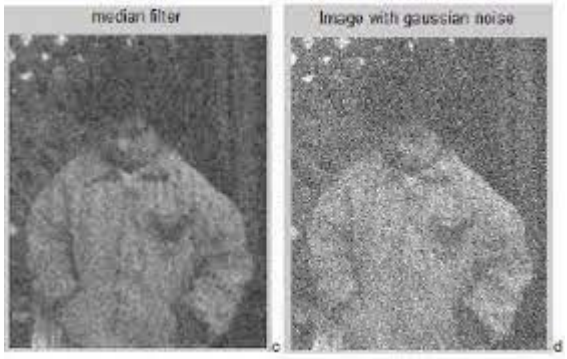
Usually filter with kernel 3x3, 5x5, 7x7 so n is usually probably.

COMPUTER ENGINEERING

Median Filter Aplication

- Median filter is one of the well-known order-statistic filters due to its good performance for some specific noise types such as “Gaussian,” “random,” and “salt and pepper” noises.
- The median filter is the filtering technique used for noise removal from images and signals. Median filter is very crucial in the image processing field as it is well known for the preservation of edges during noise removal





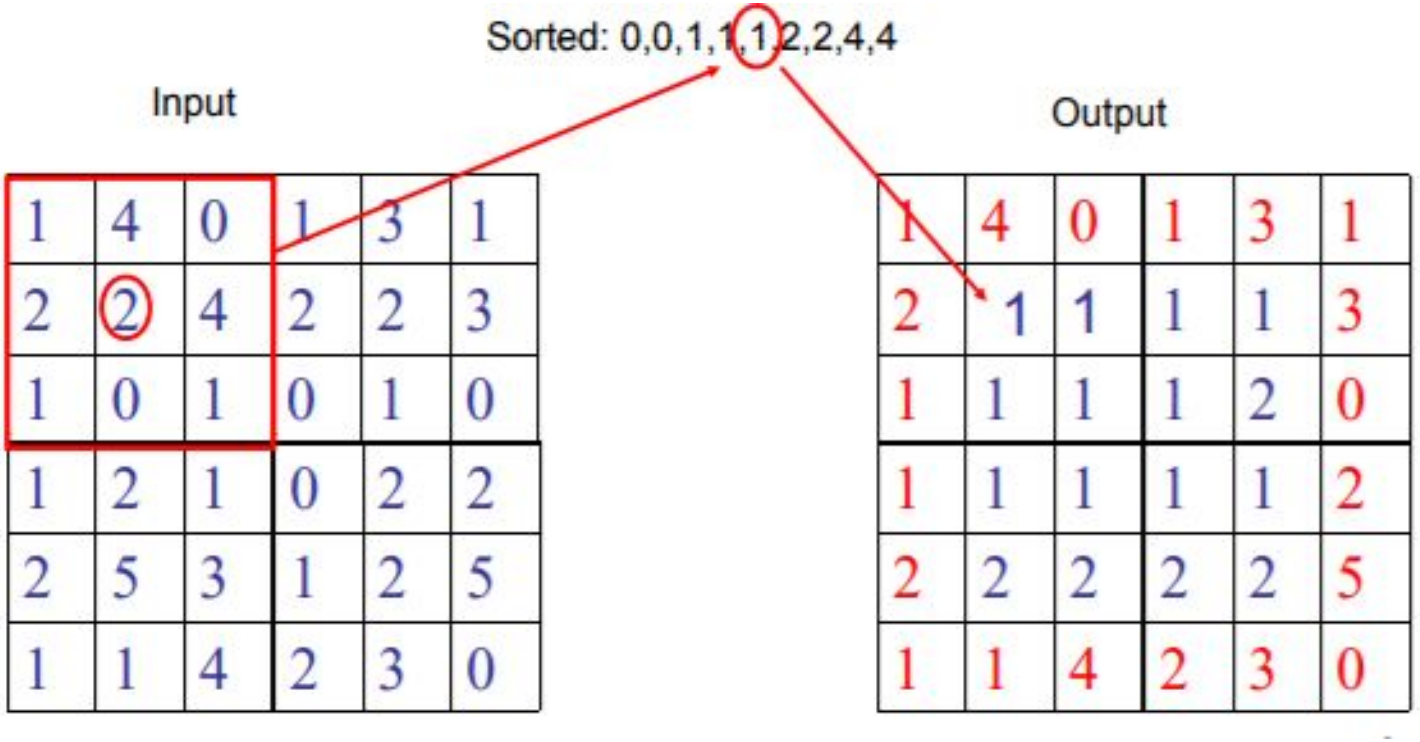
COMPUTER ENGINEERING

Median Filtering

- The median filter works by moving through each image pixel, replacing each value with the average of the neighboring pixels. pattern of neighboring pixels is called "window", slide one by one over the entire image pixel, over the whole image.
- The meadian is calculated by first sorting all the pixel values from window to numerical order, and then replace the pixel under consideration with the center pixel value (median).

Median Filtering Example

- **Example of 2D median filtering using a 3 x 3 window:**
  Keep contour values unchanged.



COMPUTER ENGINEERING

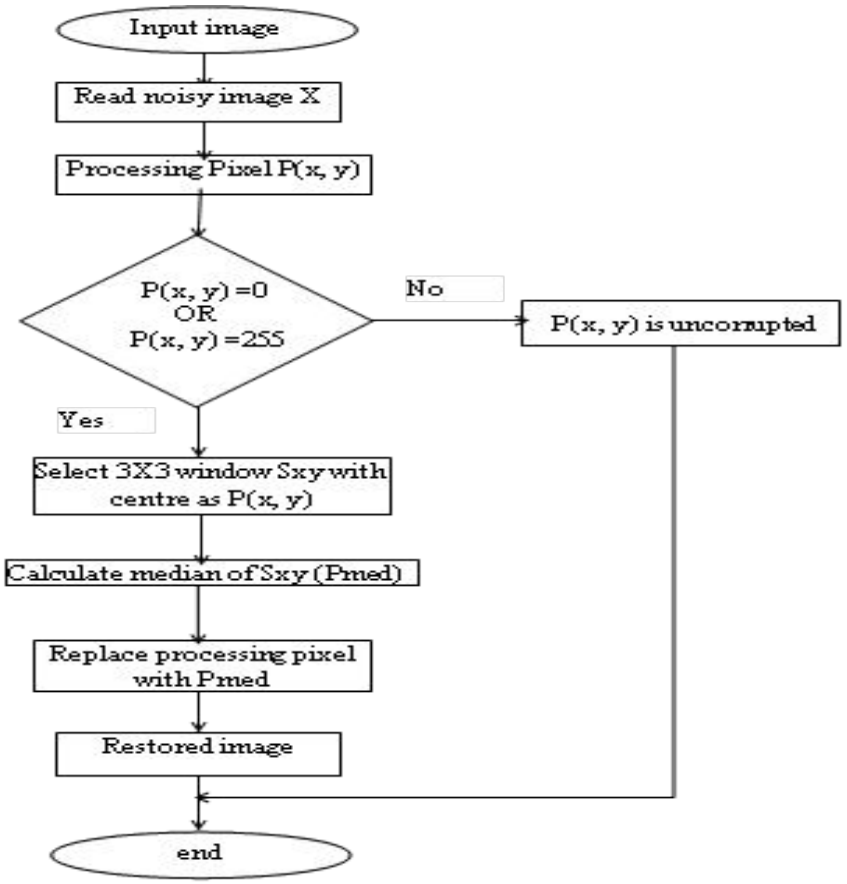
Median Filter Implementation

The steps of the algorithm:

- Select a Sxy two-way window of size 3X3, with pixel processing P(x, y).
- Calculate the median Pmed of the Sxy window.
- The value of the processing pixel is replaced by Pmed.
- Repeat the above step until the above steps are completed to get a complete image.

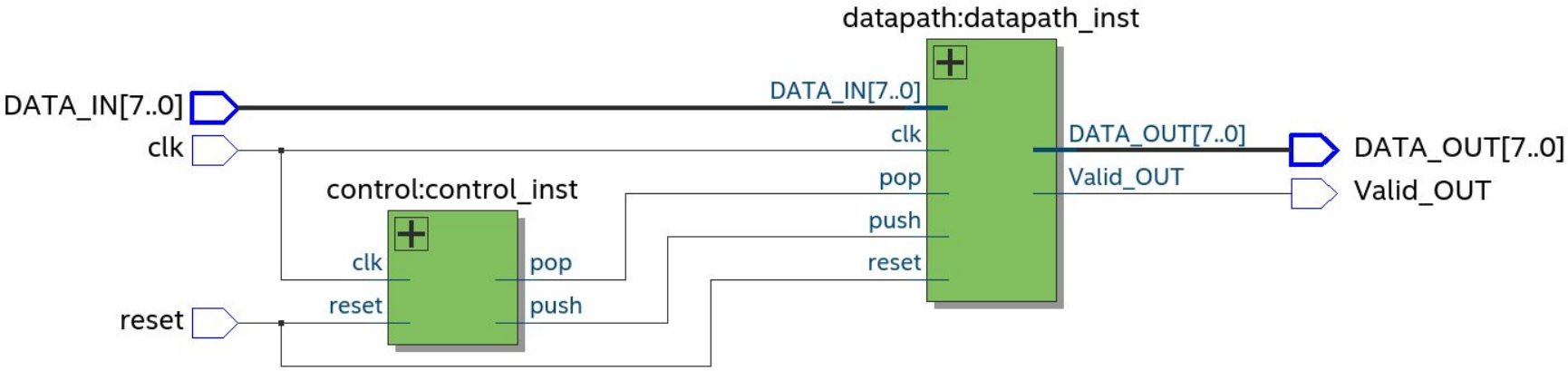
Median Filter Implementation

Flow Chart

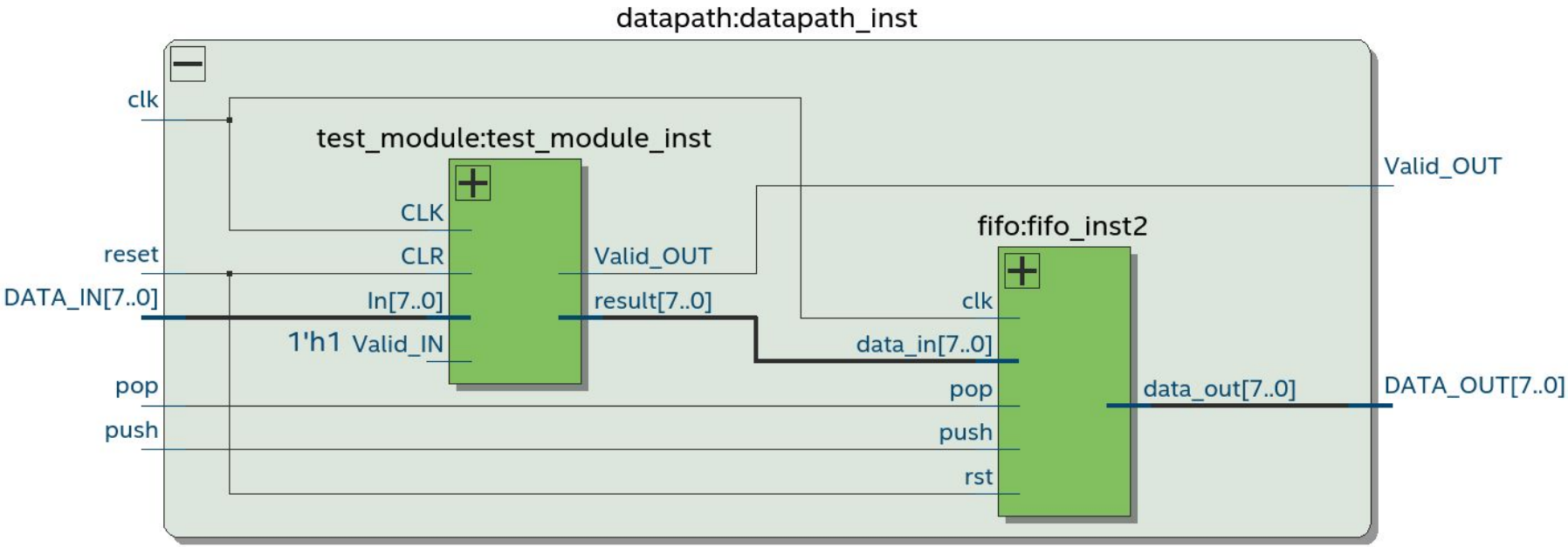


COMPUTER ENGINEERING

Median Filter Implementation



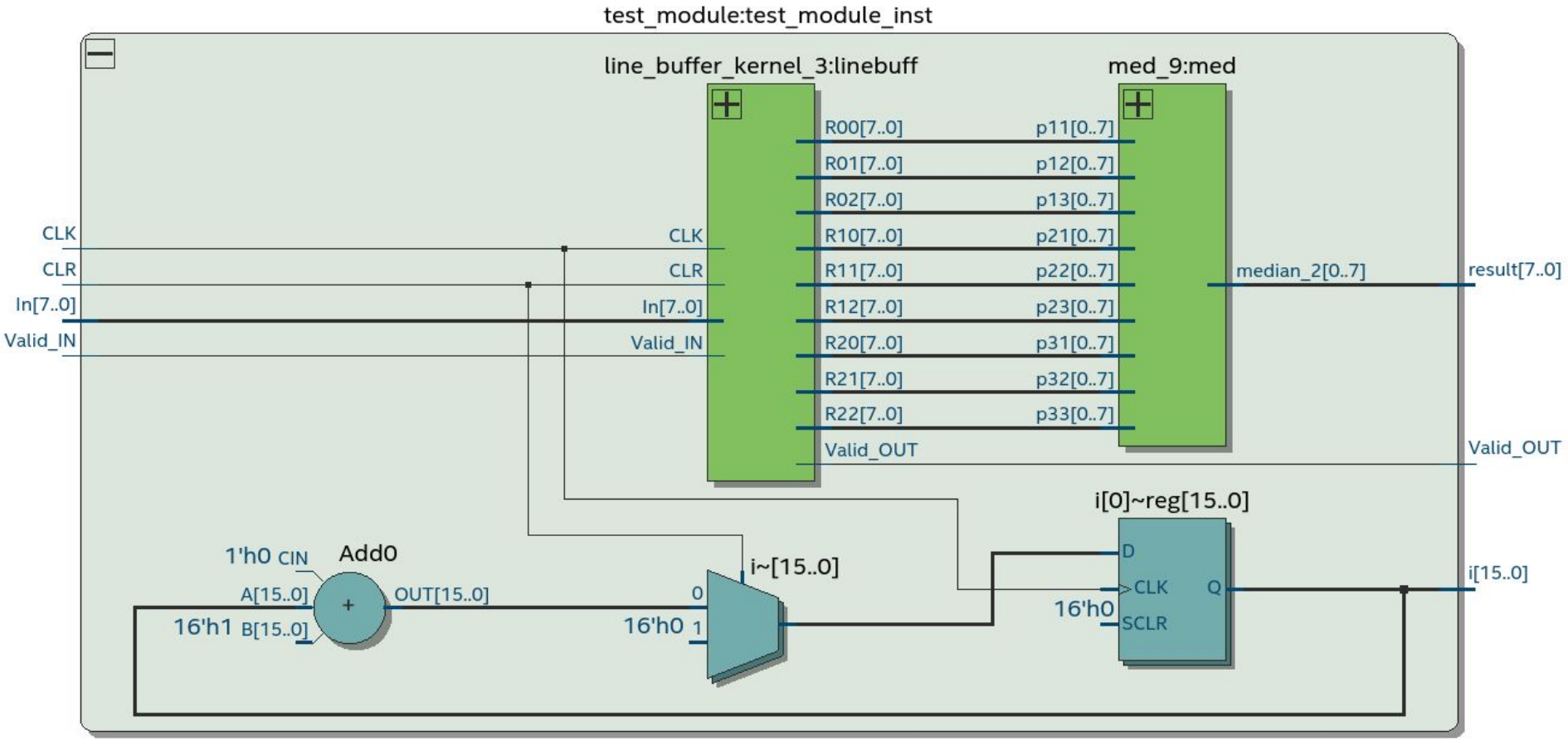
Datapath Module



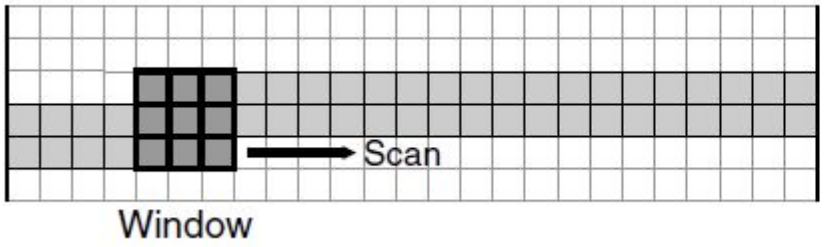
COMPUTER ENGINEERING

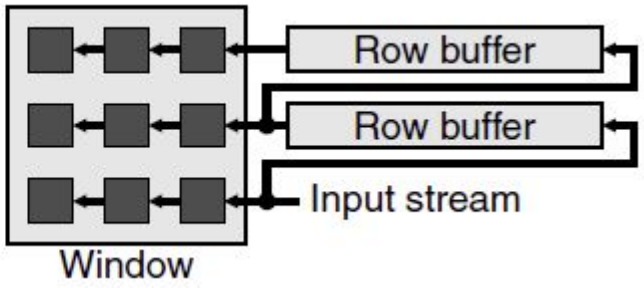
Test_module

The function is used to calculate the Median value of the image



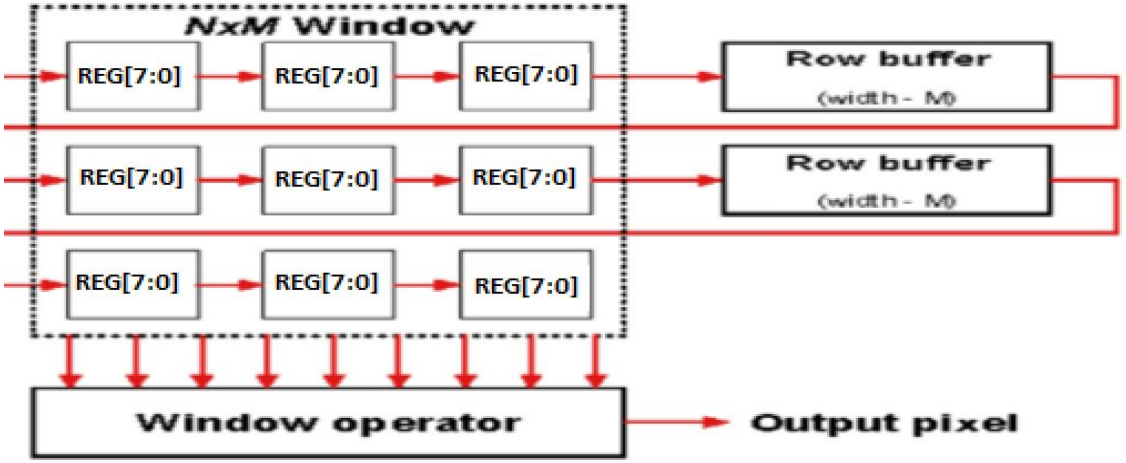
Test_module





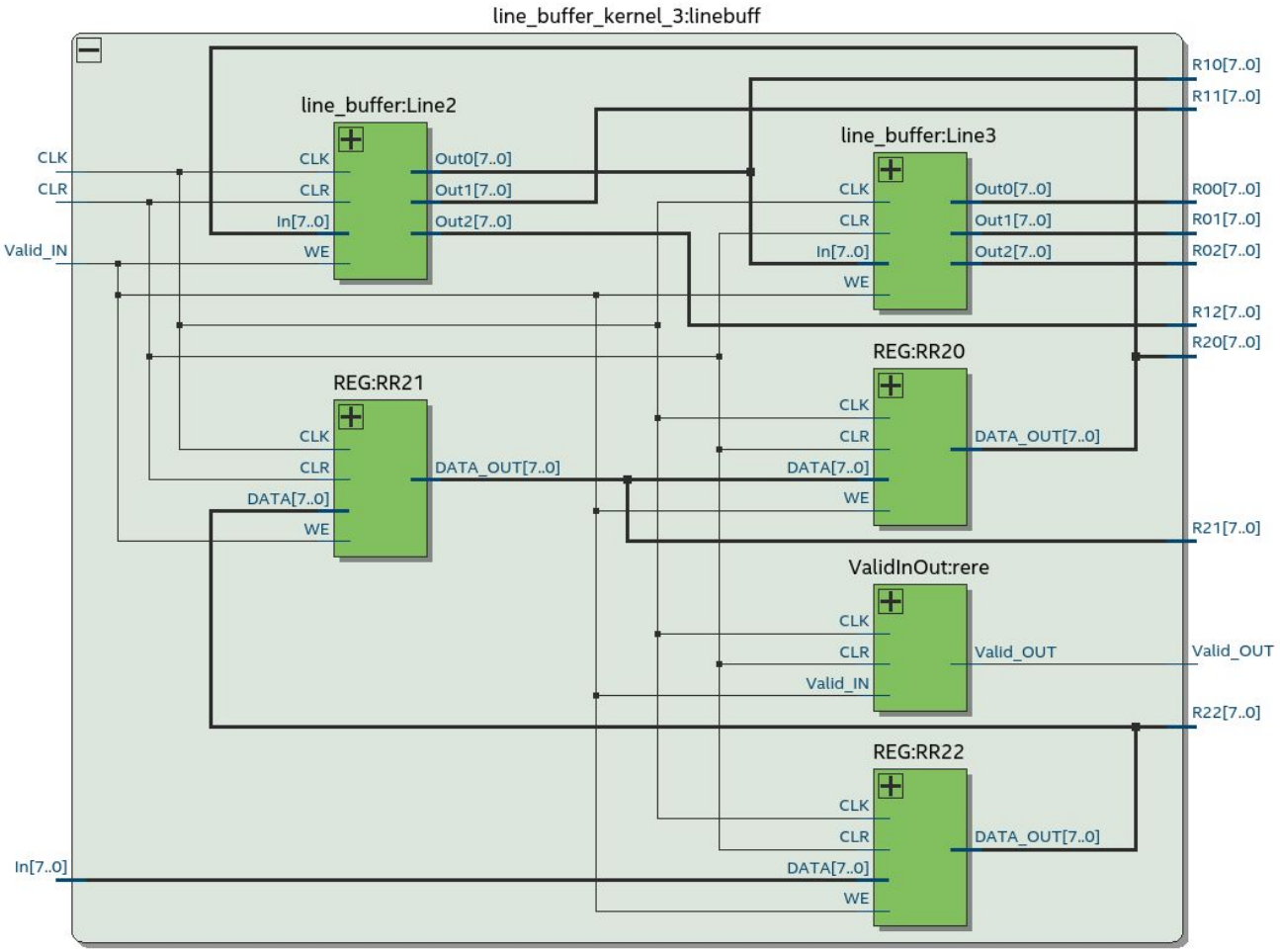
Line Buffer

- In digital image processing, line buffers are used very frequently. For example, when we need image matrix operations we need to buffer, such as image median filtering need line cache design



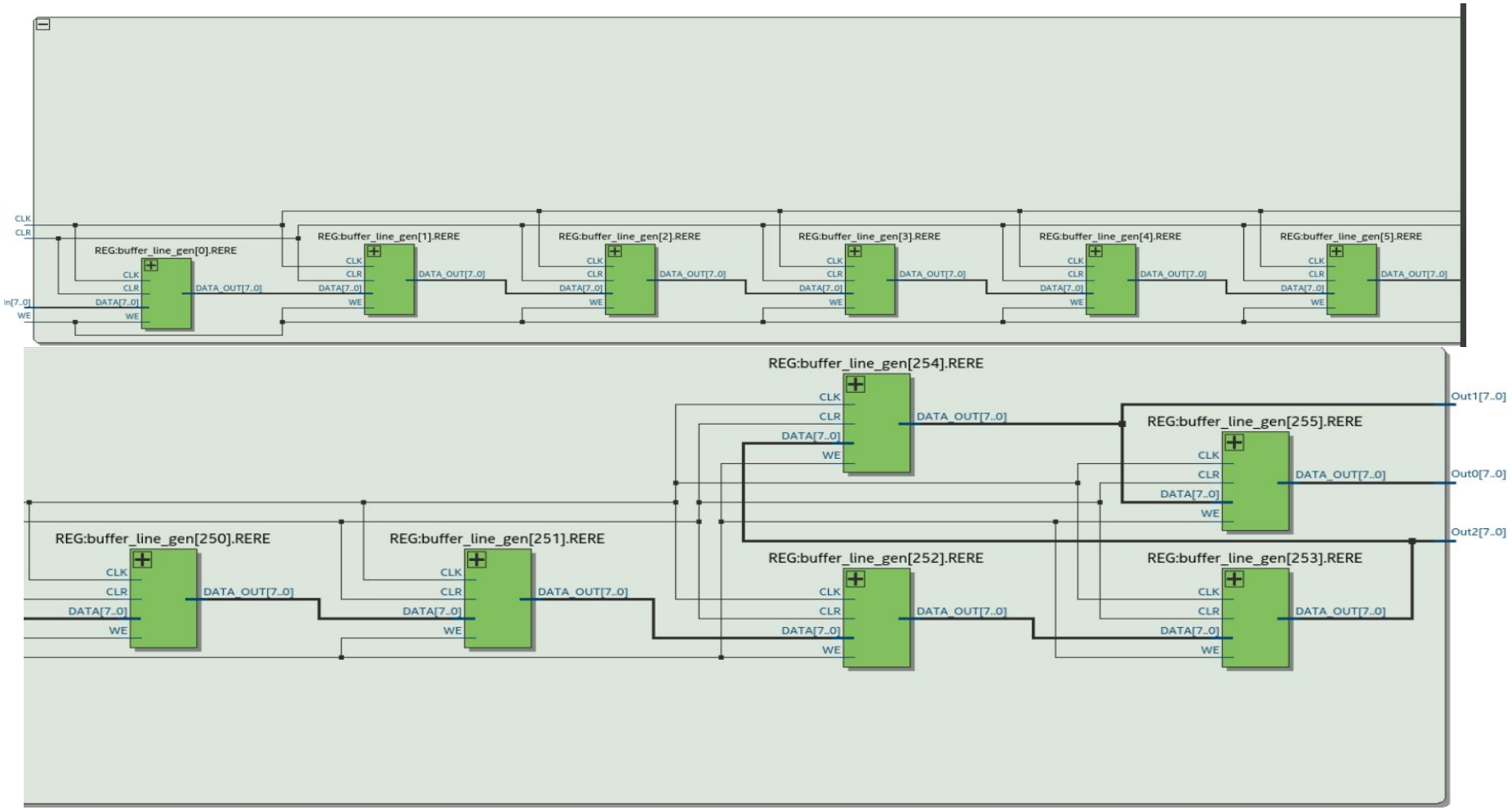
COMPUTER ENGINEERING

Line buffer Kernel



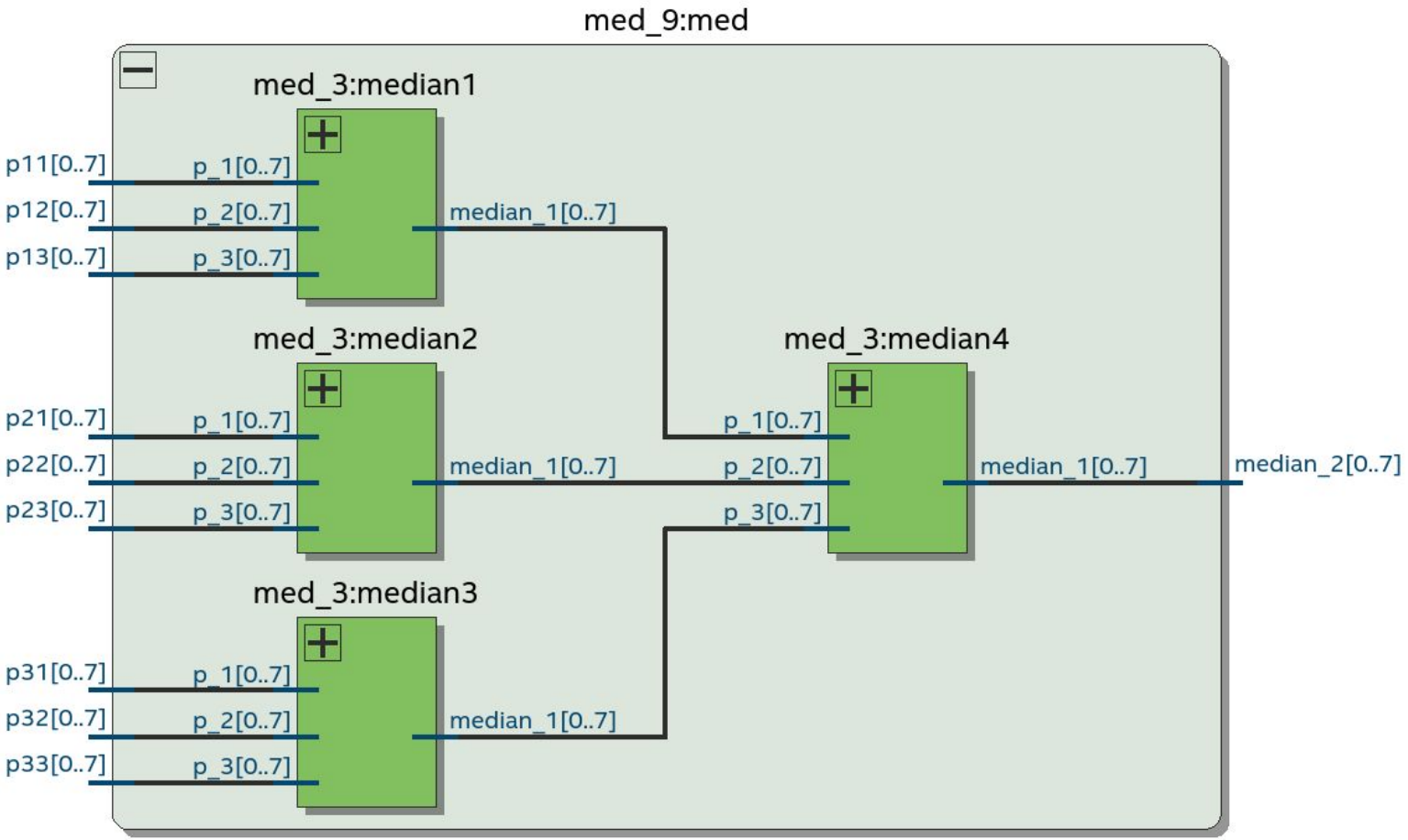
Line Buffer

include 256 registers



Median 9 module

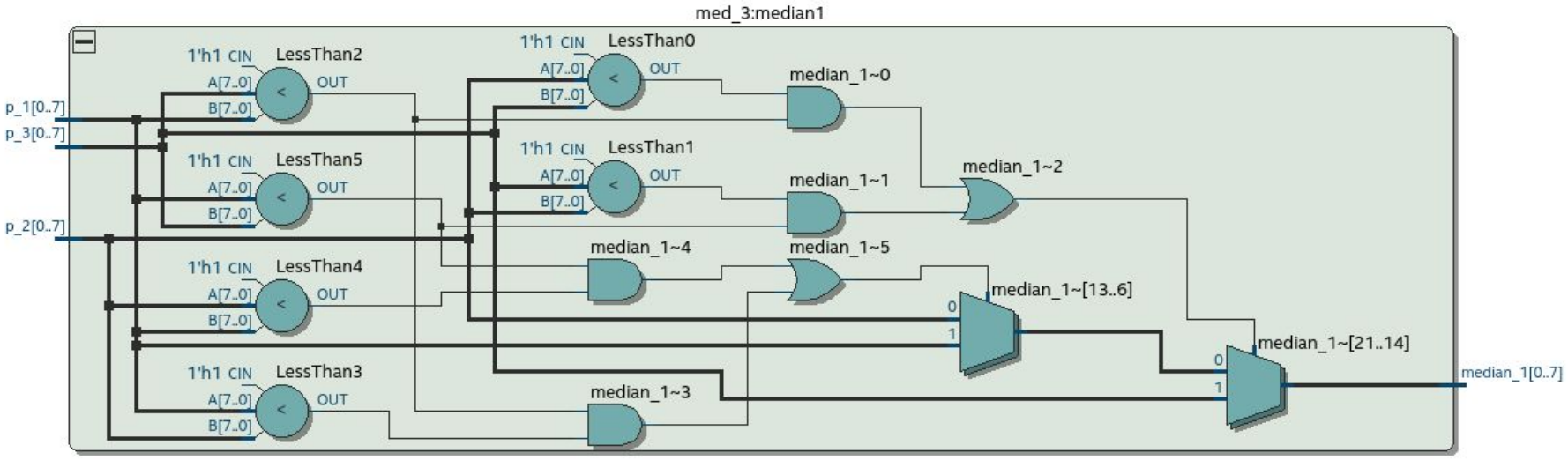
The output is median of three Med_3 module



COMPUTER ENGINEERING

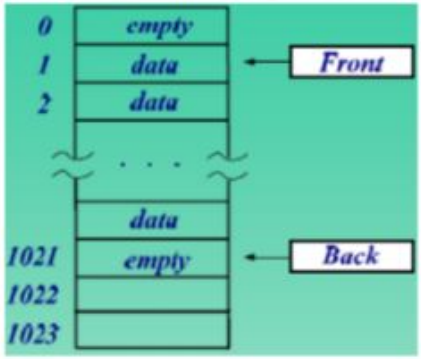
Median 3 Module

The function of median 3 mudule is calculate median value of 3 adjacent values



FIFO

FIFO queue implemented with a 1K RAM



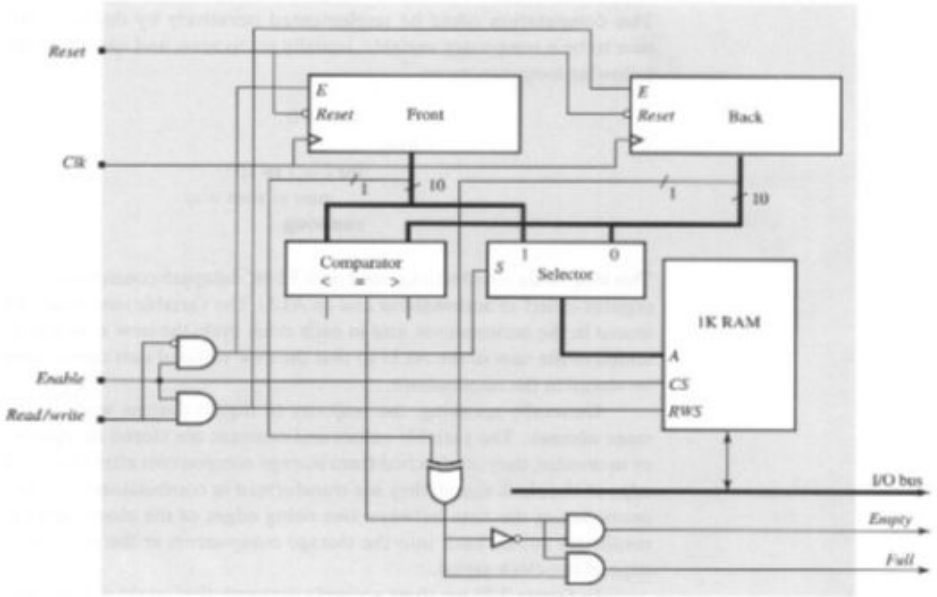
Symbolic design

Read/Write	Enable	S	CS	RWS	E (Front)	E (Back)
X	0	X	0	X	0	0
0	1	1	1	0	1	0
1	1	0	1	1	0	1

Control table

Read/Write	Enable	Operations
X	0	No change
0	1	Read
1	1	Write

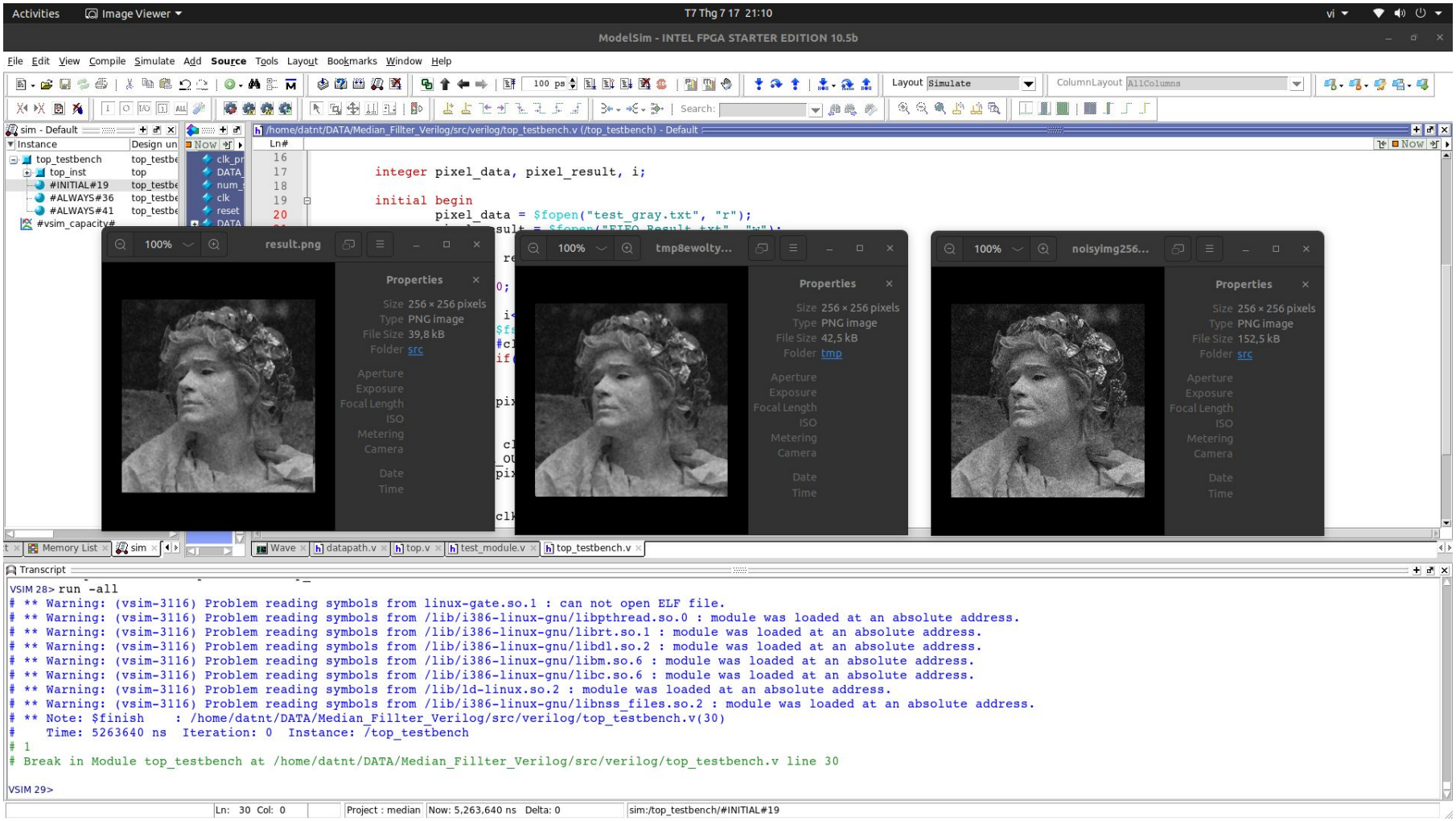
Operation table



Schematic

COMPUTER ENGINEERING

Design Results



COMPUTER ENGINEERING

UIT
TRƯỜNG ĐẠI HỌC
CÔNG NGHỆ THÔNG TIN

Thank for your attention

Q&A