Implementation of an Approximated FIR Filter on FPGA for Laser Line Extraction from Pixel Data

Internship presentation

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October 25, 2021

3D line laser scanners

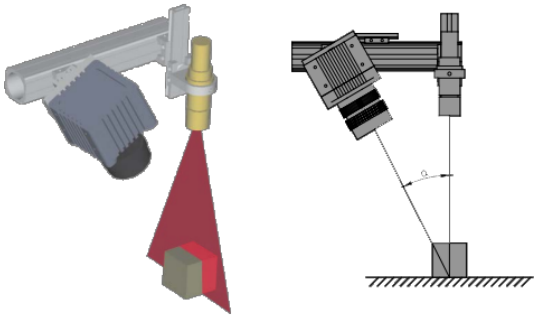


Figure: 3D laser line scanning setup

3D line laser scanners

Figure: outline of a scanned sphere

3D line laser scanners

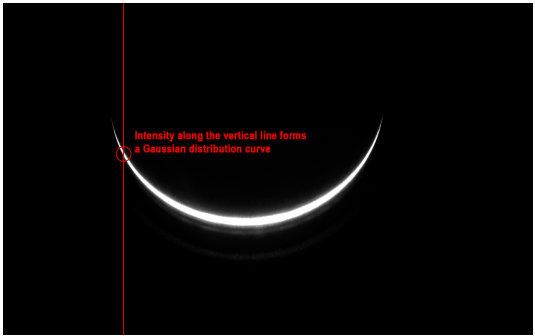


Figure: outline of a scanned sphere

3D line laser scanners

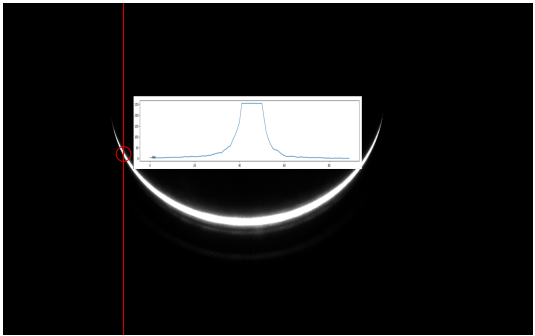


Figure: outline of a scanned sphere

line extraction

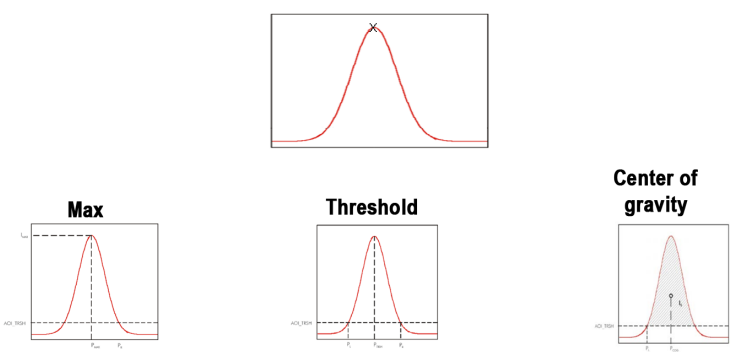


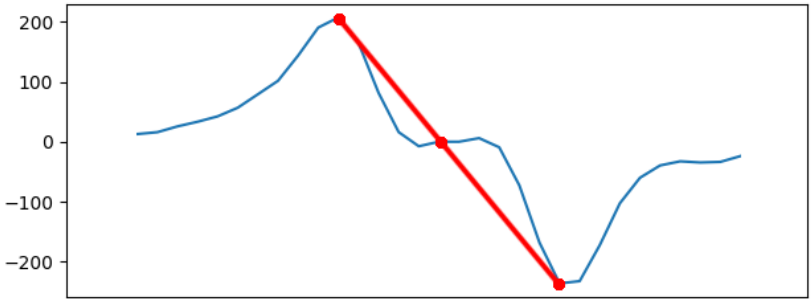
Figure: extraction methods

line extraction

Figure: differentiated vertical intensity pixel data

line extraction

zero-crossing position corresponds to the position of maximum intensity



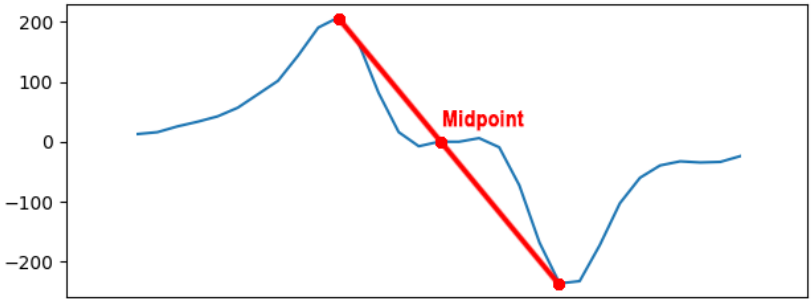
zero-crossing detection

Methods of detecting a positive to negative going zero-crossing:

- Looking for zeros
- Pattern matching [+ve, 0, -ve]
- Finding midpoint of the peaks' indices

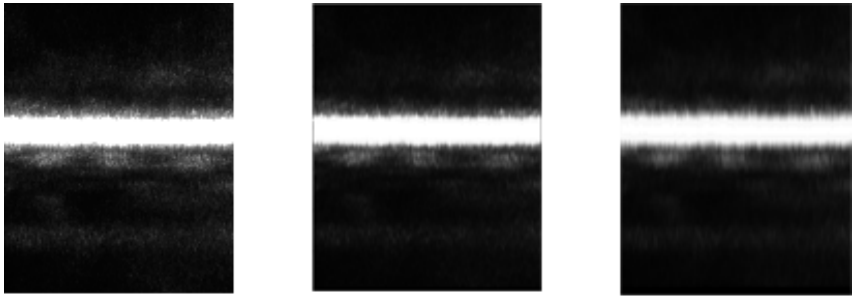
zero-crossing detection

finding the midpoint



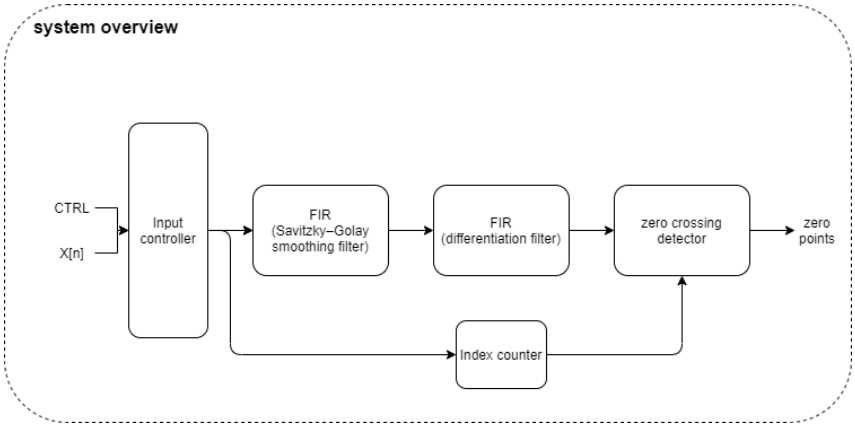
Noise reduction

Savitzky-Golay smoothing filter



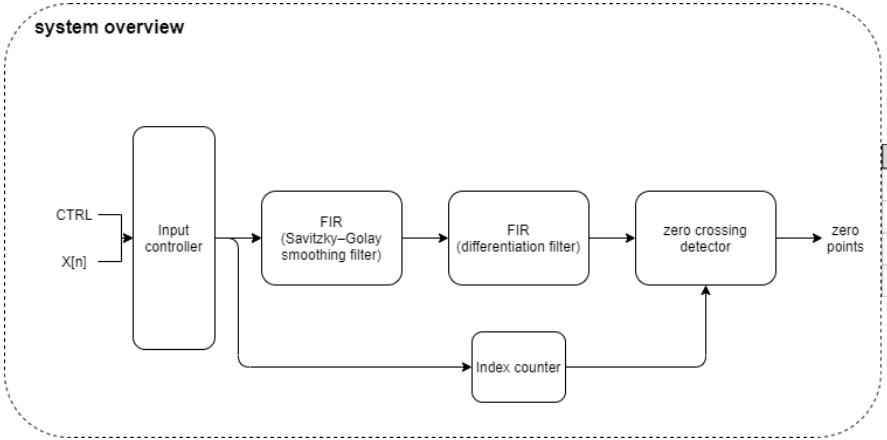
hardware implementation

Overall system diagram



hardware implementation

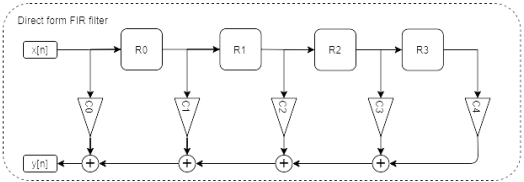
Overall system diagram

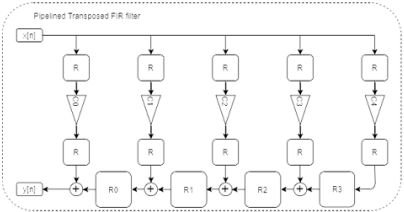


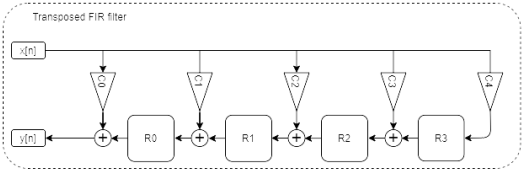
CTRL	TYPE
00	IDLE
01	START
10	DATA
11	STOP

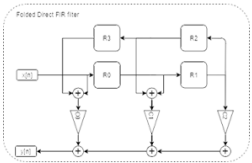
hardware implementation

FIR architecture options



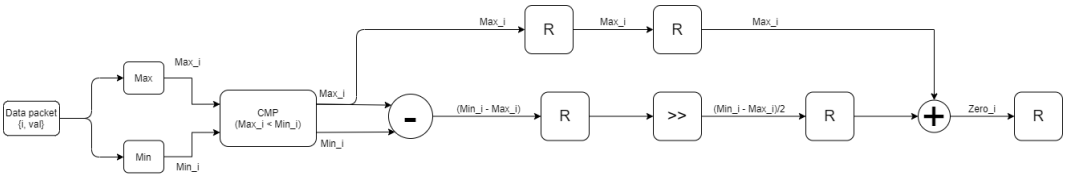






hardware implementation

Zero-crossing detector



Additional Python tools

- Filter class
- Image Viewer
- test vector generating scripts

Additional Python tools

Image viewer