Simulating SVT Online Calibrations

SVT Online Software Meeting
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Owen Long
UCSB

Plan: Use `SvtOnline`, `SvtOdf`, `CalOnline` and dataflow packages to simulate SVT online calibrations and develop SVT online calibration code.

1 Current Status

- Wrote program to translate UCSB test-stand data files into raw ROM simulator format.
- Have a working simulation of SVT threshold scan calibration using `SvtOnline`, `SvtOdf`, and `CalOnline` packages.
- Implemented three methods for determining channel threshold from scan.

2 Simulation of threshold scan

2.1 Format

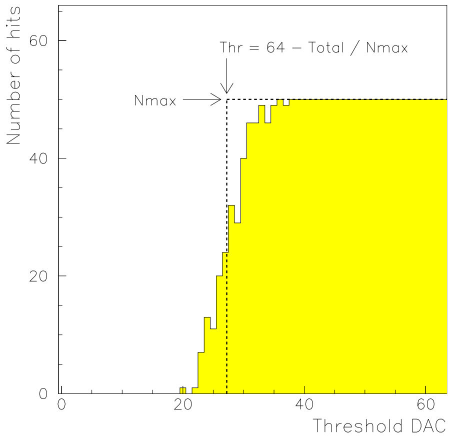
- ROM simulator receives input from two files. One contains the chip output. The other contains the chip control registers and channel masks.
- Loop through Minor cycles where each Minor cycle corresponds to a particular threshold and channel mask.
- Each Minor cycle loops through a specified number of Level 1 Accept events.

2.2 Actions for odf transitions in simulator

- **Begin Major:** Set up CalChan objects. `CalIntHist64Chan` for threshold scan at fixed cal DAC value. `CalThreshChan` for result of threshold & noise fit.
- **Begin Minor:** Reads in chip control registers, channel masks, and number of Level 1 Accepts for Minor cycle from file.
- **Level 1 Accept:** Unpack data from tagged container. Make entries in `CalIntHist64Chan` histograms.
- **End Minor:** Nothing.
- **End Major:** Fit `CalIntHist64Chan` histograms for threshold and noise. Output of fit goes into `CalThreshChan` object. Convert CalChan objects into hbook histograms and ntuples for offline analysis.

3 “Fit” Methods

3.1 Total number of hits



Area (total number of hits) is independent of noise and simply related to the threshold.

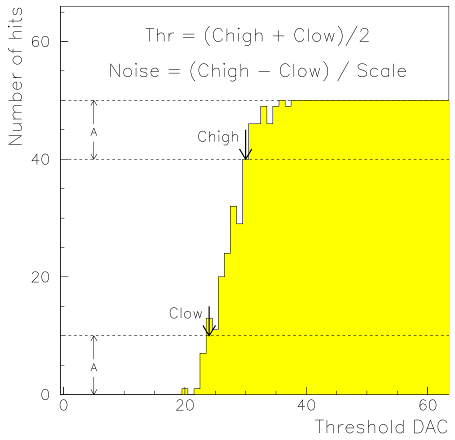
Pros:

- Very simple and fast.
- Accurate for good channels.

Cons:

- Doesn’t give measure of the noise.
- Not good for very noisy channels or channels that fall back to zero at high threshold DAC values.
- No quality indicator.

3.2 Average of two points



Use average of two points for threshold and scaled difference for noise. Scale constant determined from comparison with error function fits.

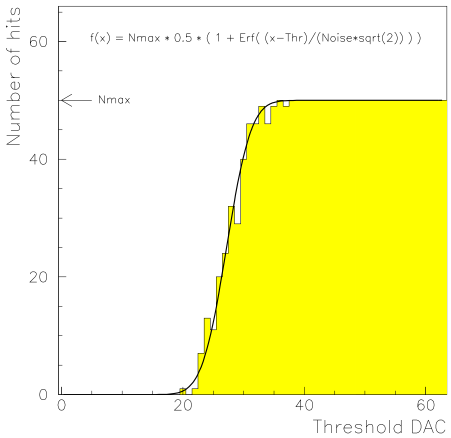
Pros:

- Very simple and fast.
- Gives noise measurement.
- Works with channels that fall back to zero at high threshold DAC values.

Cons:

- Not good for very noisy channels.
- No quality indicator.

3.3 χ^2 fit to error function



Fit to the form

$$\boldsymbol{f(x) = N_{max} \cdot \frac{1}{2} \cdot \left(1 + \mathrm{Erf}\left(\frac{x - \mathrm{Thr}}{\mathrm{Noise}\sqrt{2}}\right)\right)}$$

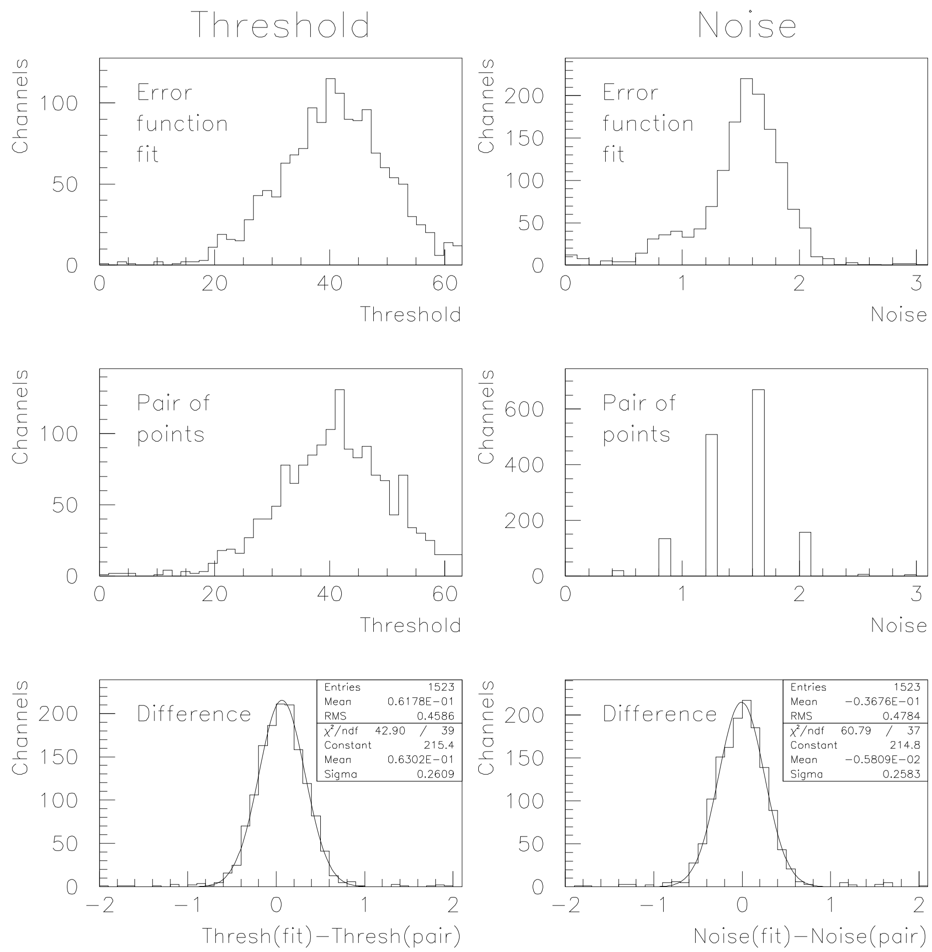
Pros:

- Most accurate method to measure threshold and noise.
- Works reasonably well with noisy channels and with channels that fall back to zero at high threshold DAC values.
- Gives quality estimate and errors on threshold & noise.

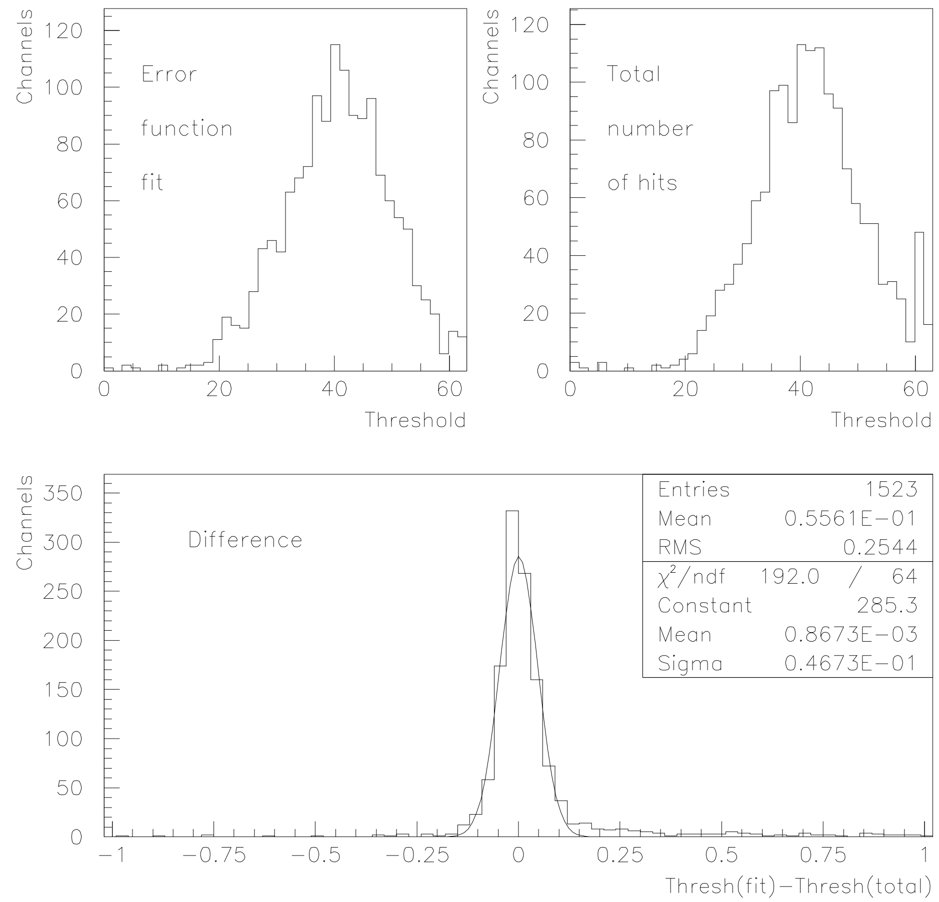
Cons:

- Slower and more complicated.

Comparison of two point method with error function fit



Comparison of total hits method with error function fit



4 Calibration run parameters

Current setup has many things hardwired in. Need to put in flexibility. Run parameters will be read in from a file at or before Begin Major.

- Detector configuration. What elements, chips, channels will be calibrated in the run?
- How many channels at a time (per Level 1 accept)?
- Number of cal DAC settings and their values for gain measurement.
- Run type: threshold scan, charge scan, shorts.
- Threshold range for scan.
- Range of fit in threshold scan.
- How many Level 1 Accepts per Minor Cycle?
- Level of detail for output.
- Type of fit for threshold scan.
- Lots of other details...