Statistical Simulation Comparison Between Exact PDF & Quick PDF & Gaussian rms Generated PDF

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Simulation Parameters

- Channel for experiment
  - \meier_02_1011\Longest Link
    - Thru_S06-P20-10-AB_S14-P23-04-CD_NNN
    - FEXT_S14-P23-03-AB_S06-P20-10-CD_NNN
- For this analysis:
  - UI = 38 ps
  - No jitter, package, or die load capacitance
  - Termination is 50 ohm single ended (100 ohm differential)
  - All signals 1 Volt at source (peak to peak, differential)
  - FFE3 in the transmitter (8 bits resolution)
    - Pre cursor tap bound -.1
    - Post cursor tap bound -.4
  - DFE5 in the receiver (9 bits resolution)
    - Target signal amplitude (threshold) = 100 mV
  - CTLE (~ 6.7 dB boost at ~ 16 GHz)
    - Zero: 3.5GHZ
    - Poles: 10GHz, 30Ghz
  - BER: target 1e-12
  - No AGC
  - 80 bins for PDFs
  - Eye height coordinate descent optimization

Power Check Between FD and TD using crosstalk signal: FD

- Find ICN with A=500 mV, UI=1/(66/64*25e9) fb=1/UI, Trf=.2*UI from clause 85 using filters

$$W_{ft}(f_n) = (A_{ft}^2/f_b)\,\mathrm{sinc}(f_n/f_b)^2\left[\frac{1}{1+(f_n/f_{ft})^4}\right]\left[\frac{1}{1+(f_n/f_r)^8}\right] \qquad \sigma_{fx} = \left[2\Delta f\sum_n W_{ft}(f_n)10^{-MDFEXT_{loss}(f_n)/10}\right]^{1/2}$$

  - Reduces to

(FD rms)

$$A*\sqrt{2\cdot\frac{\Delta f}{fb}\cdot\left[\sum_n\left[\left(sdd21\left(f_n\right)^2\cdot\mathrm{sinc}\left(\pi\cdot\frac{f_n}{f_b}\right)\right)^2\cdot\left[\frac{1}{1+\left(f_n\cdot\frac{Trf}{.2365}\right)^4}\right]\cdot\left[\frac{1}{1+\left(\frac{f_n}{fb\cdot.75}\right)^8}\right]\right]\right]}$$

Power Check Between FD and TD using crosstalk signal: TD

- Filter s-parameters like in FD

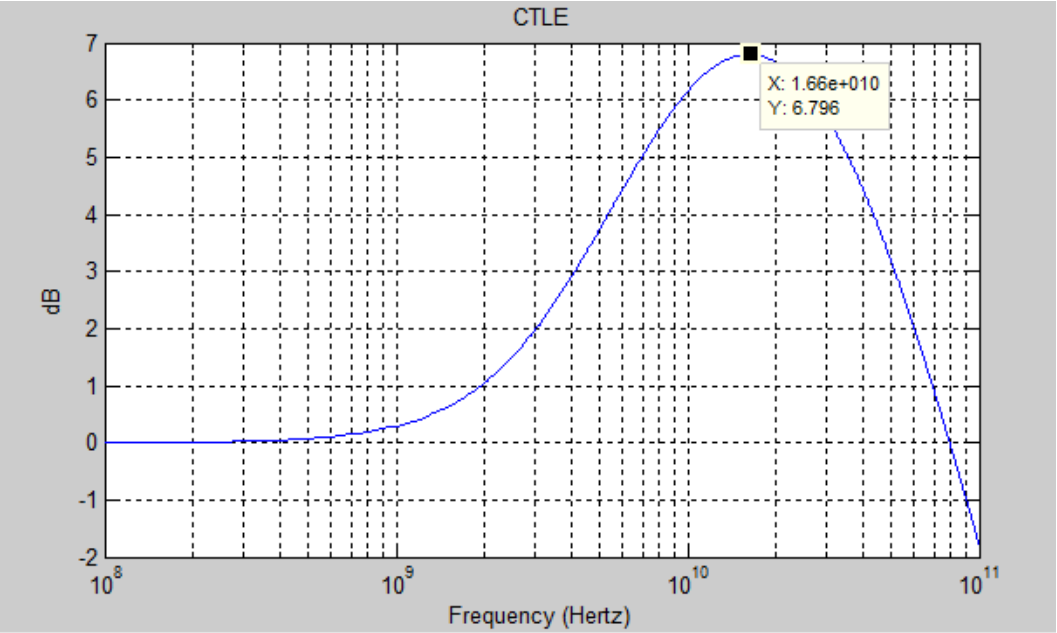
$$sdd21(f) = sdd21(f) * \sqrt{\frac{1}{1+\left(\frac{fn}{f_{ft}}\right)^4}} * \sqrt{\frac{1}{1+\left(\frac{fn}{fr}\right)^8}}$$

- Find impulse response
  - *IR=iFFT(sdd21(f))*
- *Find response to PRBS data stream with amplitude of +/- 500 mV*
  - *IR ✪ PRBS*
- *Find RMS of resultant signal (TD rms)*

FD and TD RMS's are very close

- FD rms (mv) =4.5316
- TD rms (mv) =4.535
- Seems consistent with Parseval's theorem

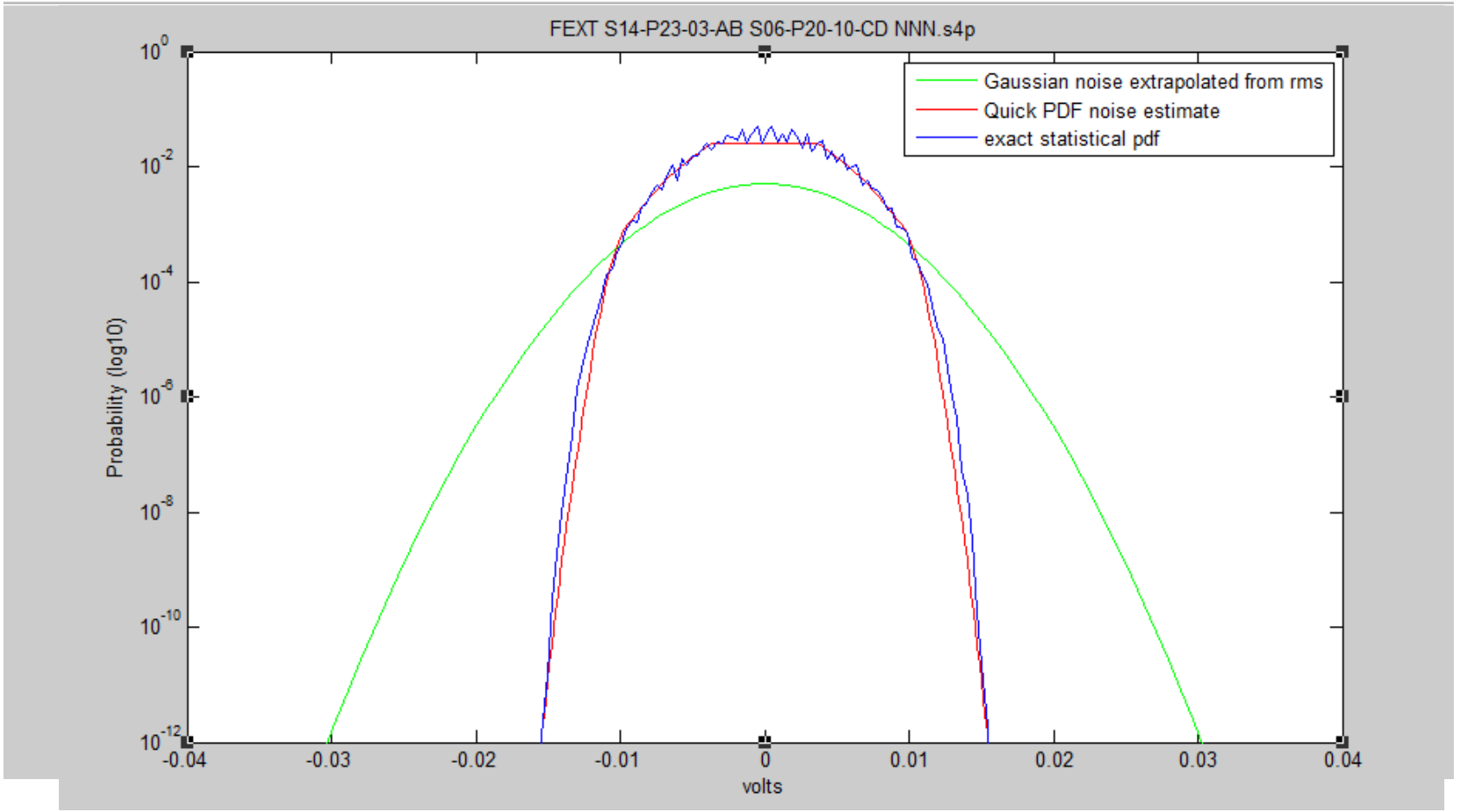
CTLE, FFE and DFE solutions



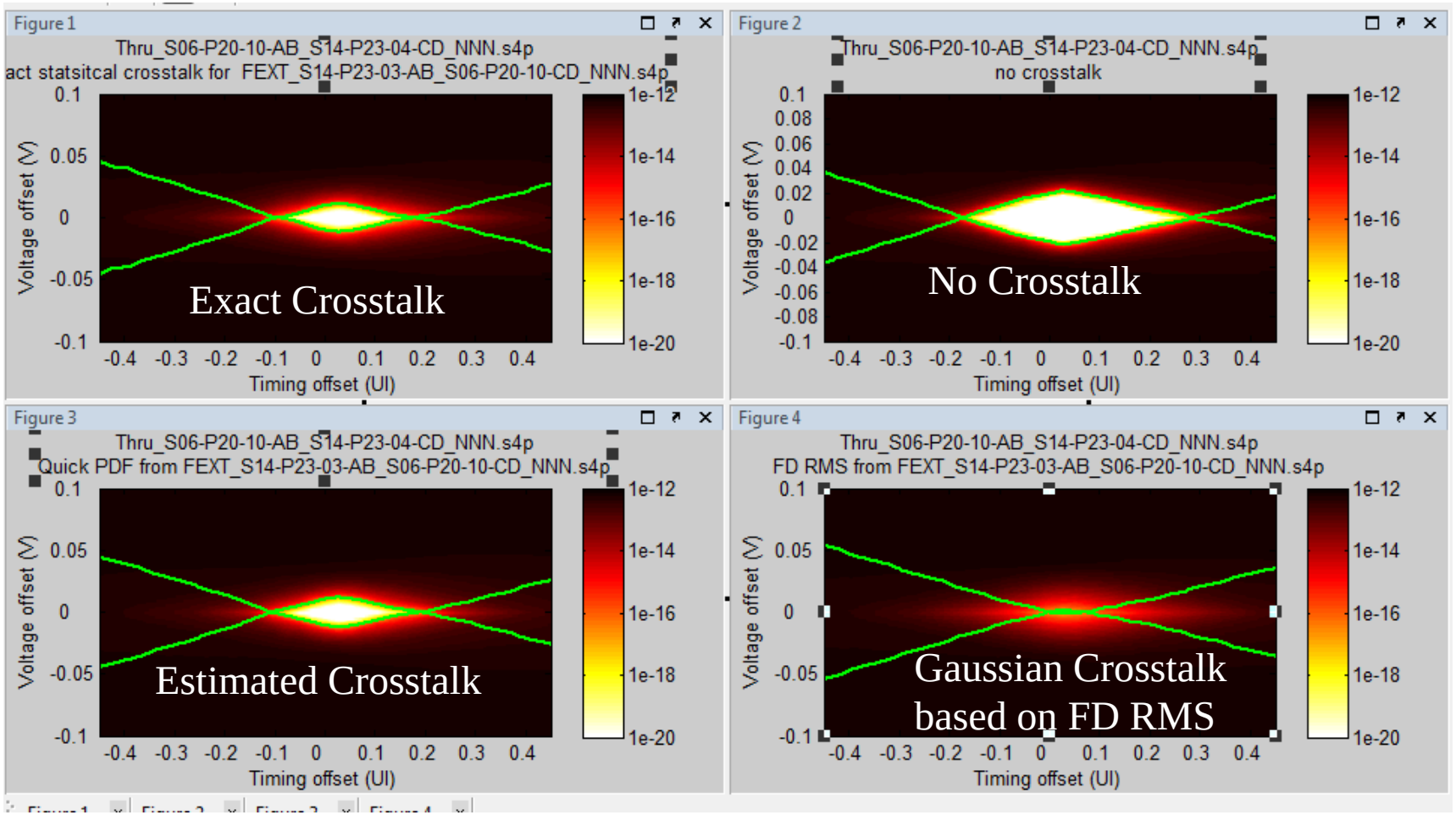
FFE taps (c-1, c0, c1) = -0.0625 0.585938 -0.35156
DFE tap (d1:5)=0.023438 -0.01172 -0.00195 0 0

- Optimization could be more tuned but they are constant across the experiment and in all cases only use the same thru file
- Simulation applies CTLE and DFE to crosstalk

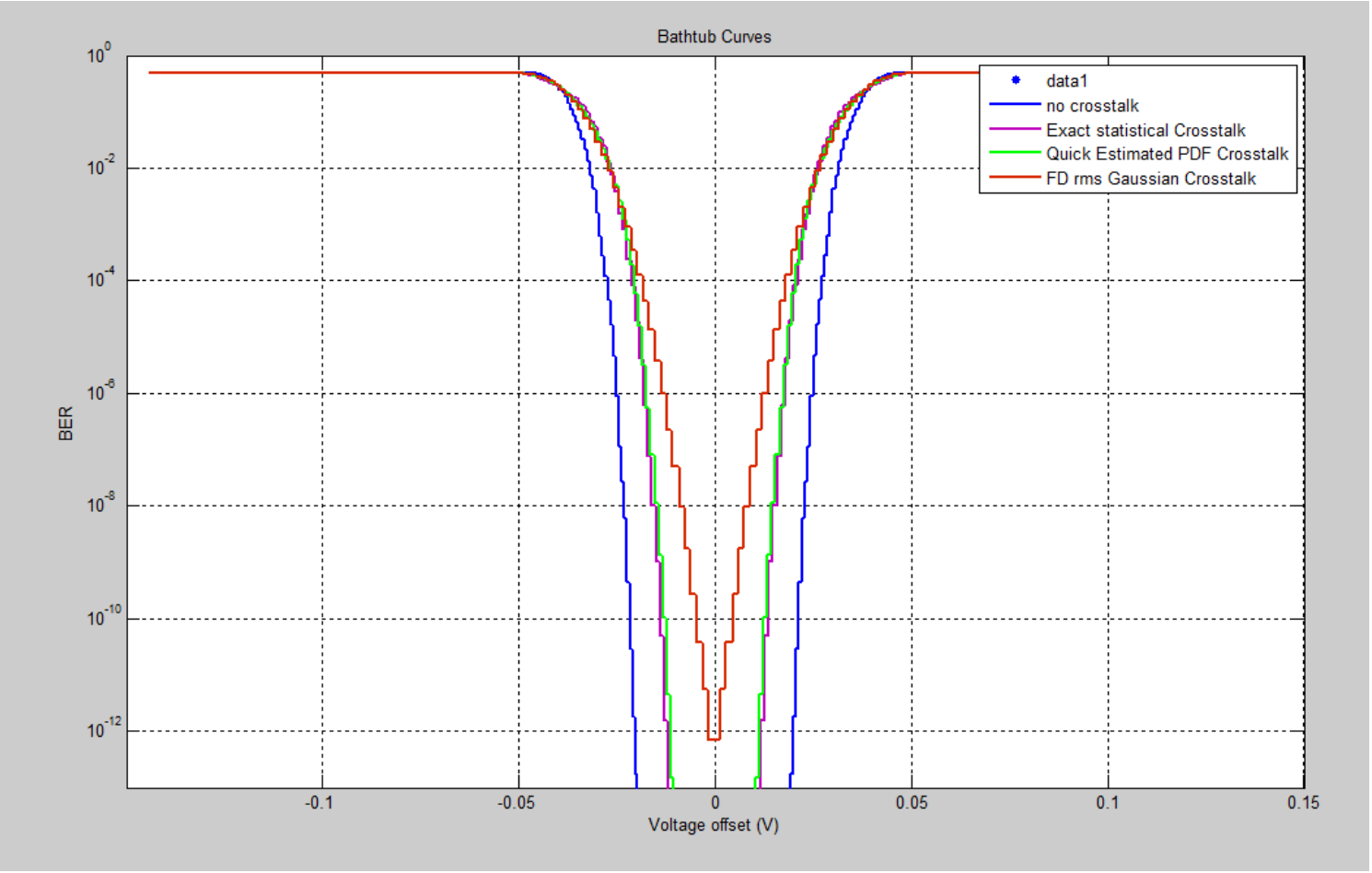
Comparison Between Probability Density Functions (PDF)



Results: Eye Diagrams



Results – Bathtub for Eye Height



Summary

- Results suggest quick PDF estimation tracks performance at target BER better than FD rms estimations
- Add more noises to analysis for next meeting
- Better explanation of the quick PDF method at next meeting.
- The key is analyzing statistics of the signals, is easier in TD but not in FD