CDAUI-8 chip-to-chip transmitter output jitter requirements

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Introduction

- The baseline proposal for CDAUI8 chip-to-chip (li_3bs_01a_0315.pdf) incorporates the 100GBASE-KP4 jitter test method (see 94.3.12.6) by reference
- 100GBASE-CR4/KR4 jitter test method (see 92.8.3.8.2) is also a viable candidate (with some modification)
- Can we take the best attributes of each method and yield an improved jitter specification?

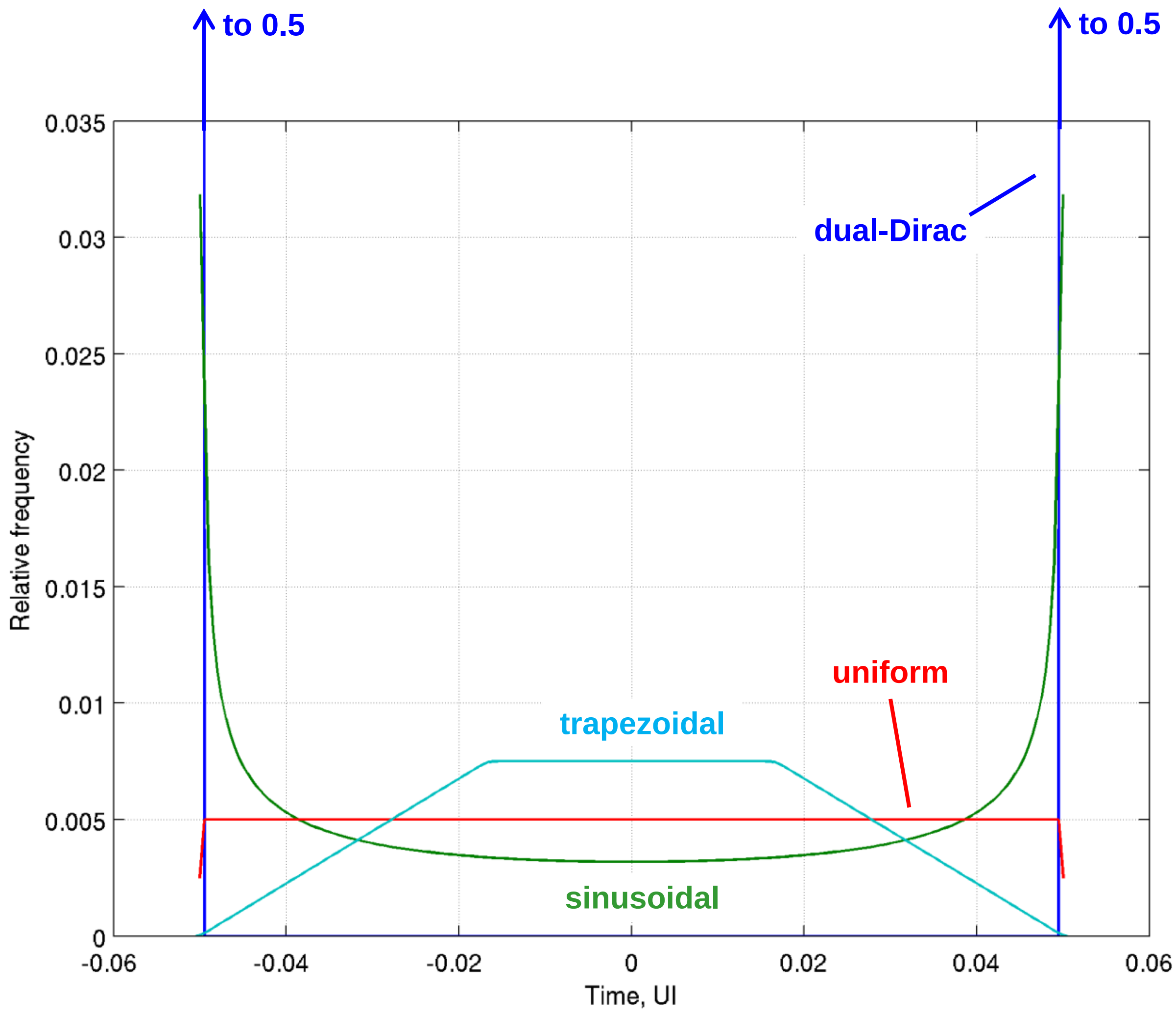
Comparison of methods

	100GBASE-CR4/KR4	100GBASE-KP4
Reference	92.8.3.8.2	94.3.12.6
Test pattern	PRBS9	JP03A (clock pattern with 2 UI period)
Data acquisition	Histogram of zero crossing times for isolated rising and falling transitions	1-shot capture and post-processing (filtering, average UI, and error calculations)
Number of samples	“Sufficient number to yield consistent results”	> 10 million UI
Curve fit reference	Dual-Dirac	Dual-Dirac
Fit range	1E−3 to 2.5E−2	1E−6 to 1E−5
Limits	Effective total uncorrelated jitter (ETUJ) and effective bounded uncorrelated jitter (EBUJ)	Clock random jitter (CRJ) and clock deterministic jitter (CDJ)

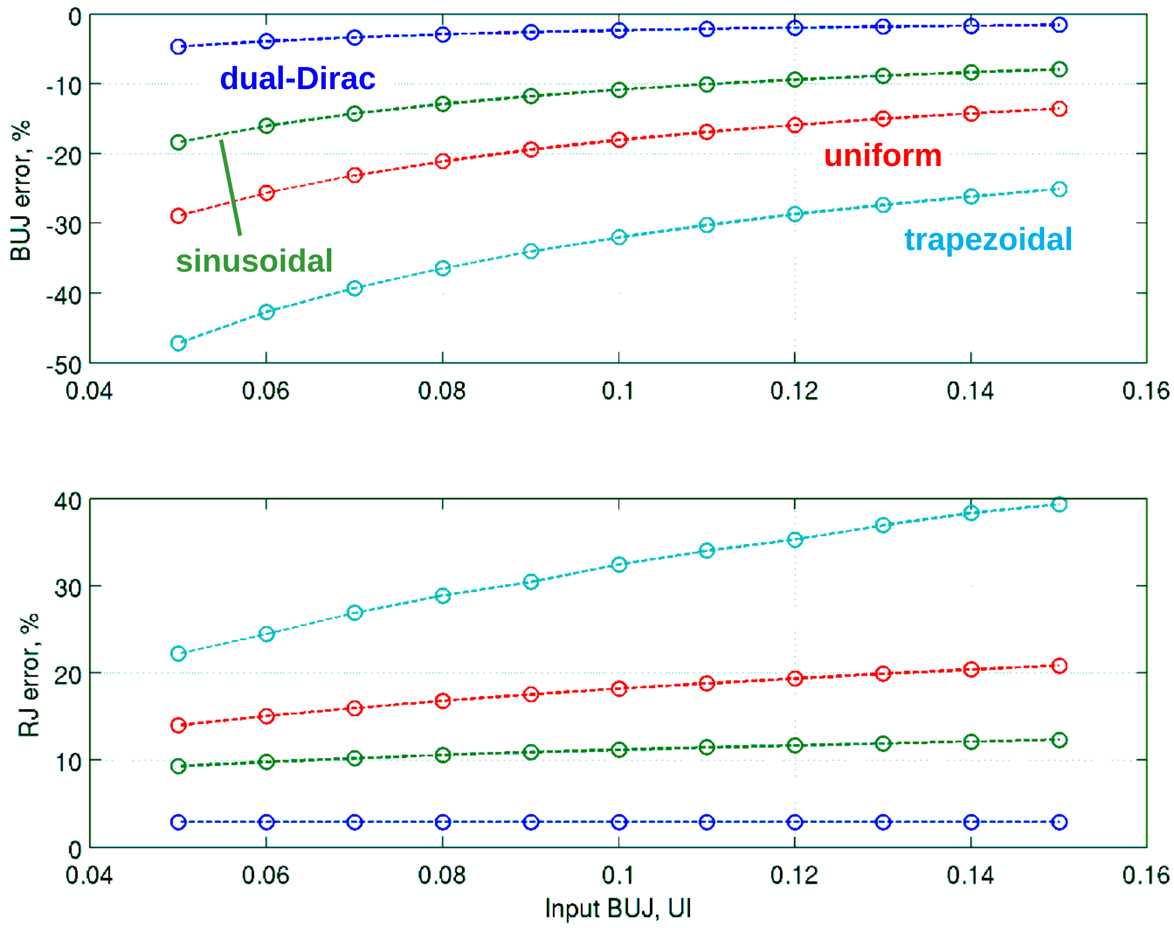
Potential concerns with the baseline method

- It is overly prescriptive on the derivation of the time error histogram
  - Any method that provides accurate time error statistics should be valid
- A separate constraint on clock random jitter can be onerous
  - Fit to dual-Dirac model maps bounded uncorrelated jitter to random jitter
  - This was also demonstrated by Moore (moore_3bj_01_0114.pdf)
  - Rationale for 100GBASE-CR4/KR4 bound on effective total and bounded uncorrelated jitter

Some bounded uncorrelated jitter distributions

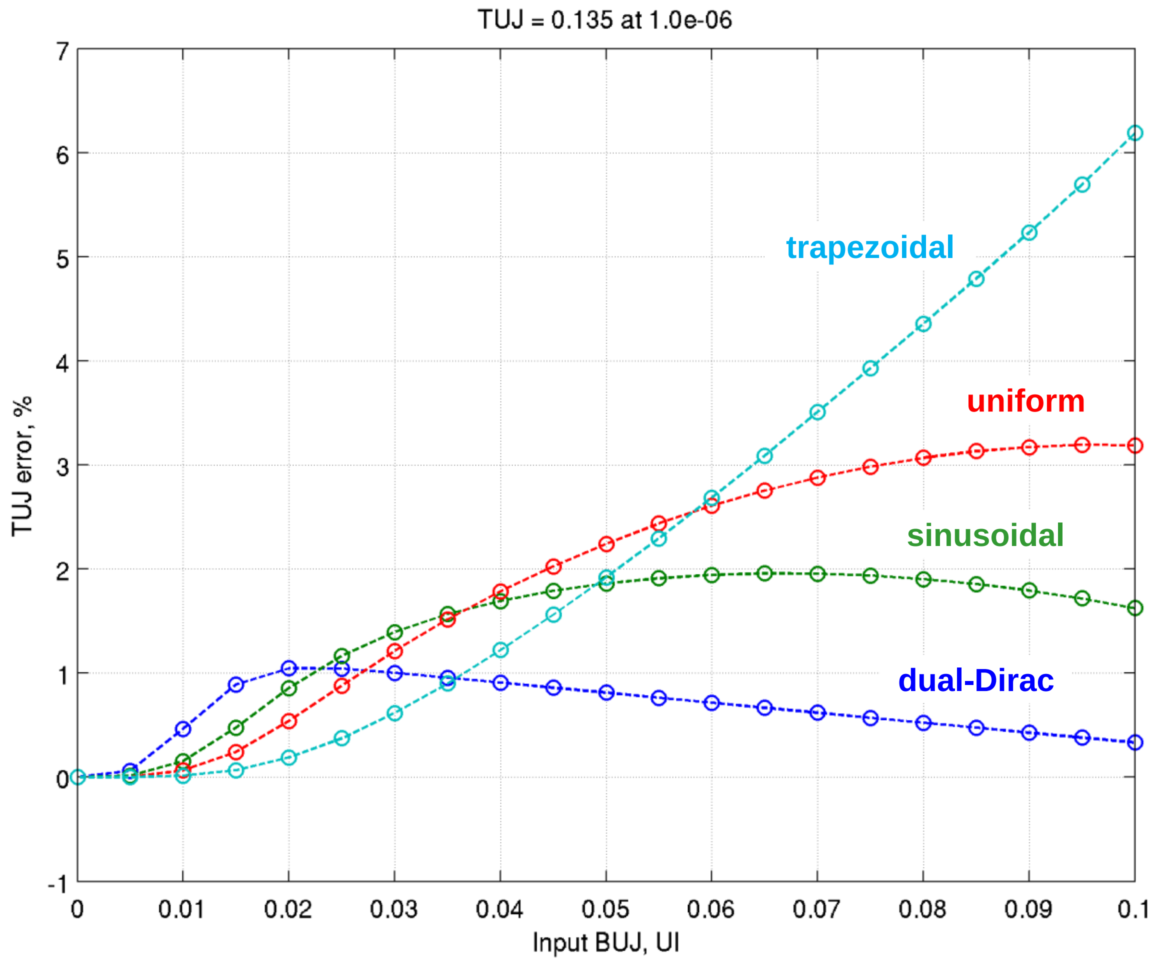


Error in fit from 1E−6 to 1E−5 (σRJ = 5 mUI)



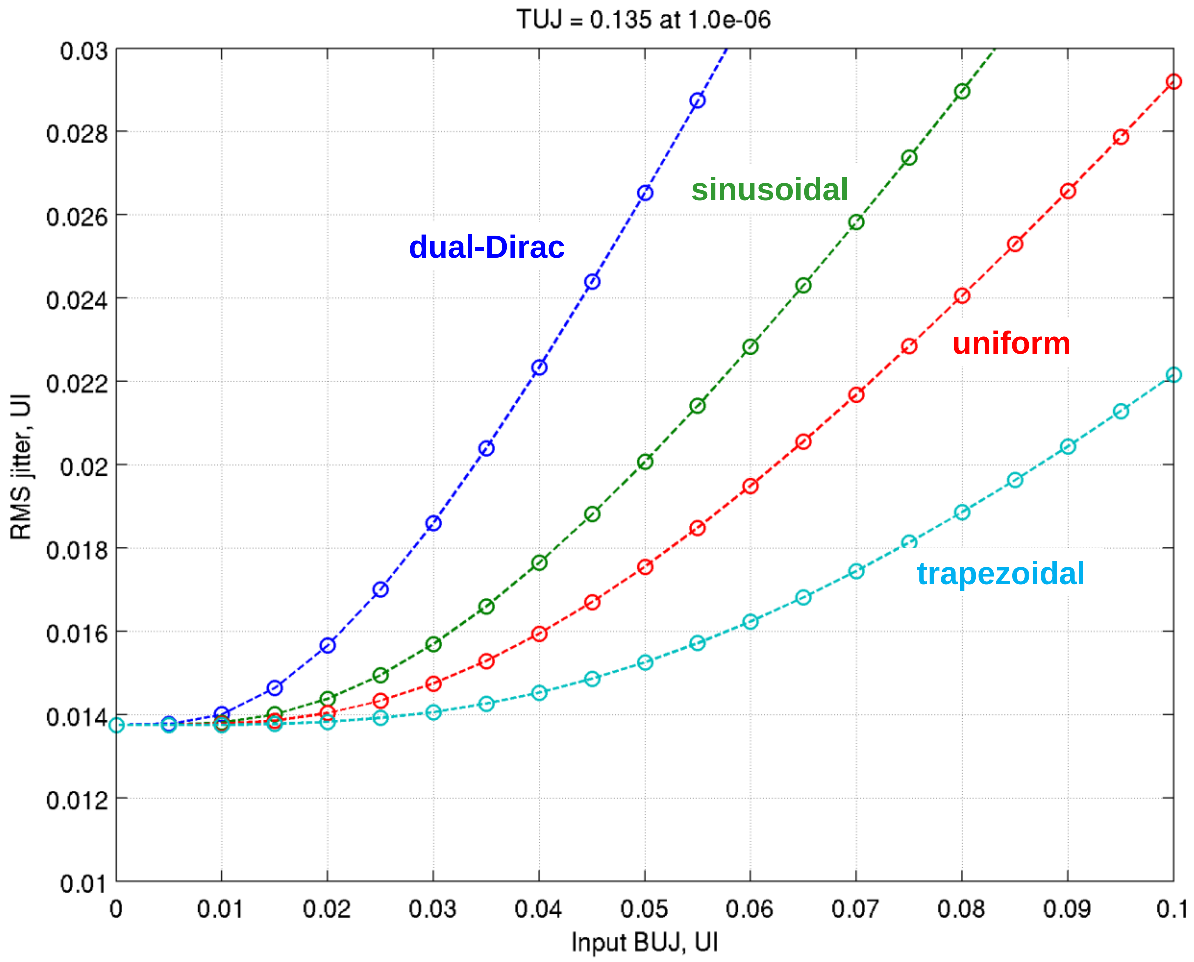
- Fitting over a lower range of probabilities reduces the fit error but it remains significant

Error in extrapolation to 1E−6 (fit from 1E−3 to 2.5E−2)



- Fitting a higher range of probability and extrapolating to the target will tend to over-estimate the total uncorrelated jitter

RMS jitter versus input bounded uncorrelated jitter



- RMS jitter is simple to measure and may be used to limit bounded uncorrelated jitter

Recommendations

- Avoid overly specific definitions of the data acquisition method
  - E.g., "measure a histogram of zero-crossing times modulo the nominal unit interval"
  - E.g., "the number of acquired samples should be sufficiently large to yield consistent measurement results"
  - The method described in 94.3.12.6 is a valid way to achieve this
- Specify total uncorrelated jitter and bounded uncorrelated jitter
  - No separate specification for RMS random jitter
- Relatively high error probability target enables direct measurement of total uncorrelated jitter
  - Extrapolation tends to over-estimate the total jitter
  - Extrapolation should still be allowed to trade-off test time for result margin
- Consider RMS uncorrelated jitter limit as a replacement for bounded uncorrelated jitter limit