Defining the training patterns

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Comments 414 and 415

Introduction

- Recommended PRBSQ patterns for training are defined in 178B.5.3

- Some of the precoded PRBS13Q patterns are unbalanced

  - The definitions of the free-running precoded PRBS13Q patterns are ambiguous

  - •The choice of seed determines the pattern, as well as determining its rotation as for non-precoded PRBS13Q

- The definition of the free-running precoded PRBS31Q pattern is ambiguous too

  - (There is no synchronous PRBS31Q)

- This presentation provides more information and proposes solutions

The comments

- 414 Cl 178B SC 178B.3.5.1 P 746 L 20   TR

- Precoded training pattern 1 might not be well balanced.

- Check precoded patterns for balance. If there is a problem, change the default seed so as to rotate the pattern by a few UI to make the precoding start as intended.

- 415 Cl 178B SC 178B.5.4 P 748 L 35   TR

- The free-running precoded training patterns are not adequately defined.

- For the 8 precoded PRBS13Q, define the pattern as the one that would be generated if the seed were as in Table 178B-1 (and see another comment*), and the precoder state is set to 0. As the pattern runs across the training frame, the actual start position doesn't matter as long as the intent to avoid correlation between lanes is met. For the free-running precoded PRBS31Q, define the pattern as in 120.5.11.2.2 with the precoder state set to 0.
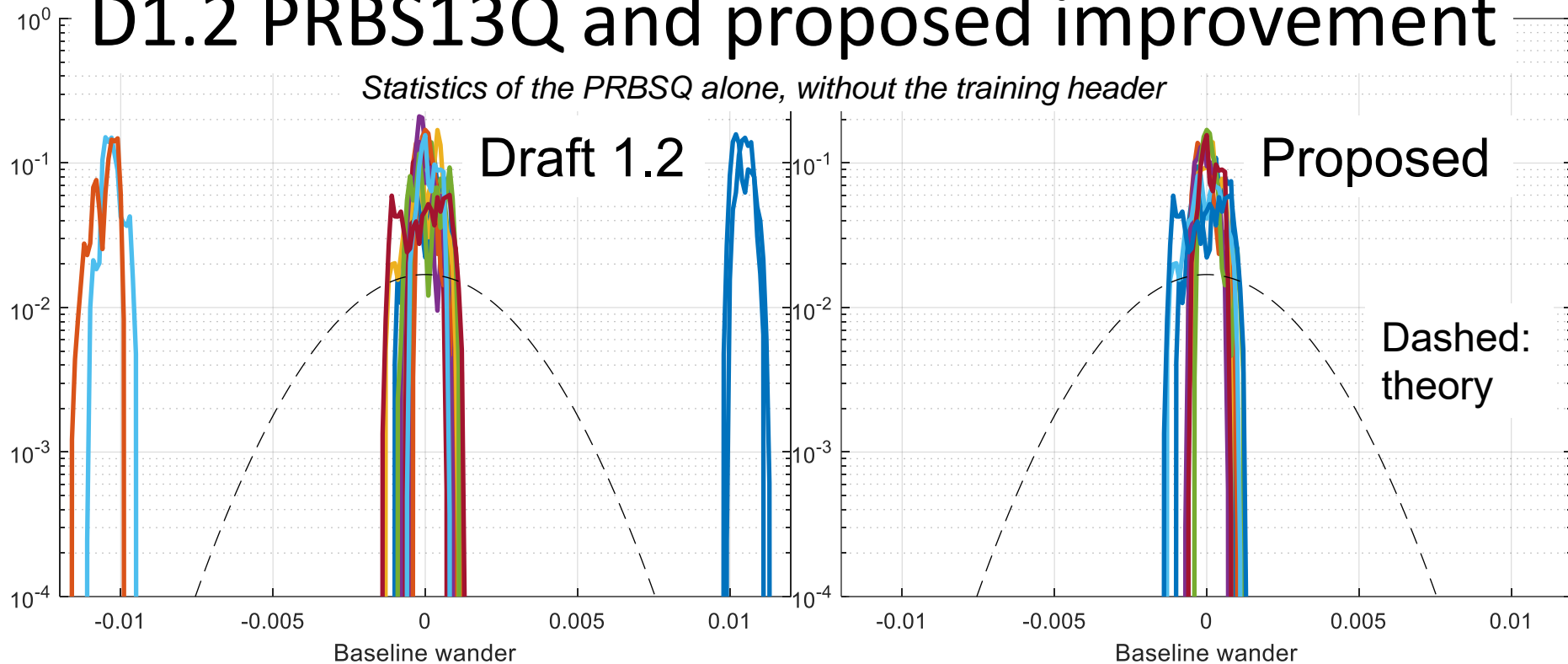
  – * Comment 414, above

D1.2 PRBS13Q and proposed improvement

Statistics of the PRBSQ alone, without the training header

Draft 1.2

Proposed

Dashed: theory

- Baseline wander statistics of the possible PRBS13Q, 4 polynomials, both precoded and not, any seed
- Four unbalanced patterns should be avoided
  - The standard should warn against creating these
- The two on the left are precoded, *i* is 1 or 5, with the default seed
  - The two on the right are precoded, "Default identifier" (polynomial ID) 3, and a non-default seed
- Some patterns are 8191 UI long, some precoded patterns are 16382 UI long

- Baseline wander statistics of the proposed set of PRBS13Q, 4 polynomials (8 *i*), both precoded and not, revised default seeds
- The unbalanced patterns are avoided
  - for the proposed default seeds
- The 4 non-precoded patterns are 8191 UI long, the 4 precoded patterns are all 16382 UI long
  - Nice minor benefit

Revised default seeds (for both synchronous and free-running)

i	Default identifier (ID of polynomial)	Default seed_i		Comments
		D1.2	Proposed	
0	0	0000010101011	0000010101011	
1	1	0011101000001	0111010000011	Rotated 1 bit
2	2	1001000101100	1001000101100	
3	3	0100010000010	0100010000010	
4	0	1111110100110	1111110100110	
5	1	1100011101110	1000111011100	Rotated 1 bit
6	2	0000001101000	0000001101000	
7	3	0011000100111	0011000100111	

To avoid ambiguity, it may be desirable to add another UI to the "Initial output, PAM4 with precoding" column

Checking the correlations
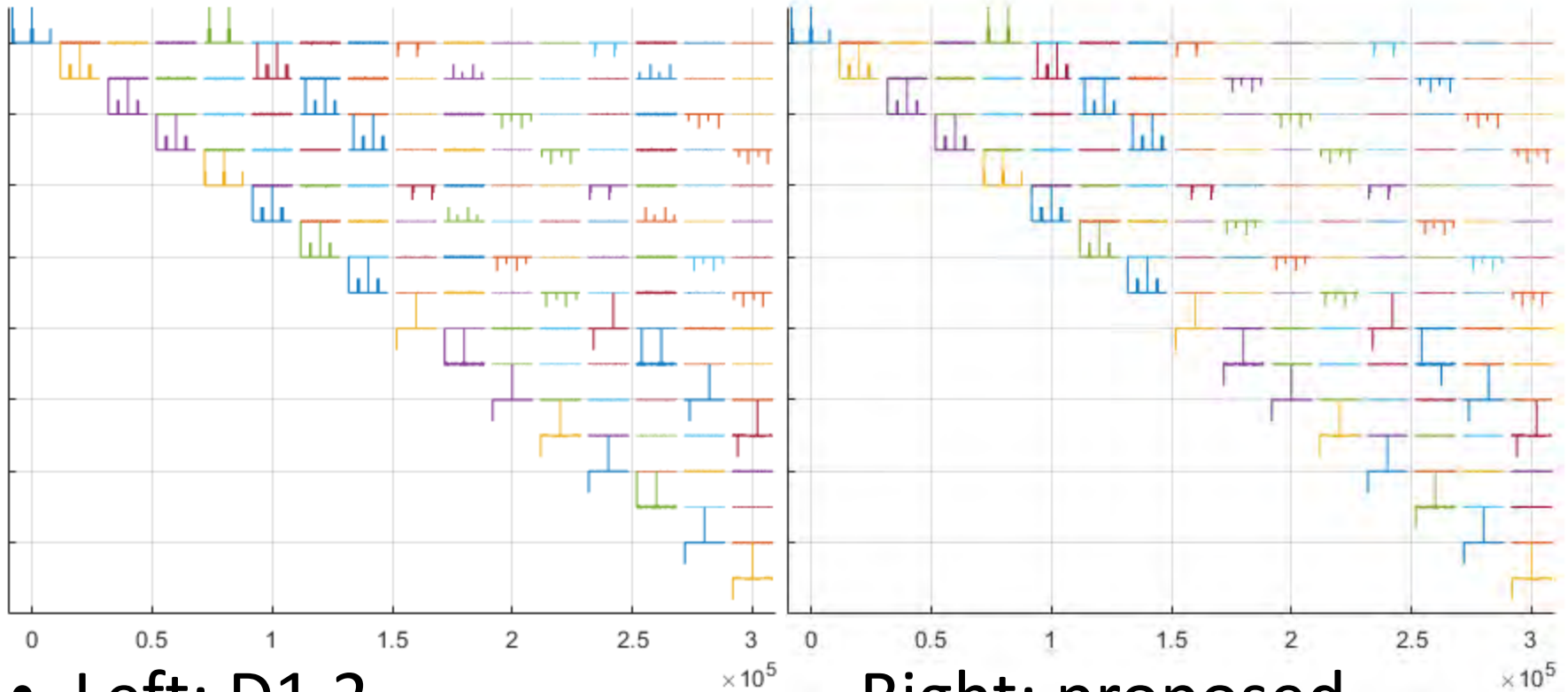
- Left: D1.2   Right: proposed
- The sign of some correlation peaks is changed
- Otherwise, no significant difference. See table on next slide, and backup slides

Tabulated correlations

i \/	Poly	0	1	2	3	4	5	6	7	0p	1p	2p	3p	4p	5p	6p	7p
i >		0	1	2	3	4	5	6	7	0p	1p	2p	3p	4p	5p	6p	7p
i \/	Poly	0	1	2	3	0	1	2	3	0	1	2	3	0	1	2	3
0	0	0.9999	-0.042	-0.06	-0.039	0.9999	-0.042	-0.06	-0.039	-0.4	-0.042	0.0259	-0.017	-0.4	-0.042	0.0259	-0.017
1	1		0.9999	0.0412	0.0533	-0.042	0.9999	0.0412	0.0533	0.0188	0.3998	-0.017	-0.025	0.0188	0.3998	-0.017	-0.025
2	2			0.9999	-0.028	-0.06	0.0412	0.9999	-0.028	0.0305	-0.04	-0.4	0.0094	0.0305	-0.04	-0.4	0.0094
3	3				0.9999	-0.039	0.0533	-0.028	0.9999	0.0173	0.0471	0.0094	-0.4	0.0173	0.0471	0.0094	-0.4
4	0					0.9999	-0.042	-0.06	-0.039	-0.4	-0.042	0.0259	-0.017	-0.4	-0.042	0.0259	-0.017
5	1						0.9999	0.0412	0.0533	0.0188	0.3998	-0.017	-0.025	0.0188	0.3998	-0.017	-0.025
6	2							0.9999	-0.028	0.0305	-0.04	-0.4	0.0094	0.0305	-0.04	-0.4	0.0094
7	3								0.9999	0.0173	0.0471	0.0094	-0.4	0.0173	0.0471	0.0094	-0.4
0p	0									1	-0.019	0.0368	-0.035	1	-0.019	0.0368	-0.035
1p	1										0.9997	-0.019	-0.02	-0.019	0.9997	-0.019	-0.02
2p	2											1	-0.034	0.0368	-0.019	1	-0.034
3p	3												1	-0.035	-0.02	-0.034	1
4p	0													1	-0.019	0.0368	-0.035
5p	1														0.9997	-0.019	-0.02
6p	2															1	-0.034
7p	3	As in D1.2 /\		Proposed \/													1
0	0	0.9999	-0.042	-0.06	-0.039	0.9999	-0.042	-0.06	-0.039	-0.4	0.0188	0.0259	-0.017	-0.4	0.0188	0.0259	-0.017
1	1		0.9999	0.0412	0.0533	-0.042	0.9999	0.0412	0.0533	0.0188	-0.4	-0.017	-0.025	0.0188	-0.4	-0.017	-0.025
2	2			0.9999	-0.028	-0.06	0.0412	0.9999	-0.028	0.0305	-0.018	-0.4	0.0094	0.0305	-0.018	-0.4	0.0094
3	3				0.9999	-0.039	0.0533	-0.028	0.9999	0.0173	-0.026	0.0094	-0.4	0.0173	-0.026	0.0094	-0.4
4	0					0.9999	-0.042	-0.06	-0.039	-0.4	0.0188	0.0259	-0.017	-0.4	0.0188	0.0259	-0.017
5	1						0.9999	0.0412	0.0533	0.0188	-0.4	-0.017	-0.025	0.0188	-0.4	-0.017	-0.025
6	2							0.9999	-0.028	0.0305	-0.018	-0.4	0.0094	0.0305	-0.018	-0.4	0.0094
7	3								0.9999	0.0173	-0.026	0.0094	-0.4	0.0173	-0.026	0.0094	-0.4
0p	0									1	0.0405	0.0368	-0.035	1	0.0405	0.0368	-0.035
1p	1										1	0.0399	-0.033	0.0405	1	0.0399	-0.033
2p	2											1	-0.034	0.0368	0.0399	1	-0.034
3p	3												1	-0.035	-0.033	-0.034	1
4p	0													1	0.0405	0.0368	-0.035
5p	1														1	0.0399	-0.033
6p	2															1	-0.034

Candidate PRBS31Q
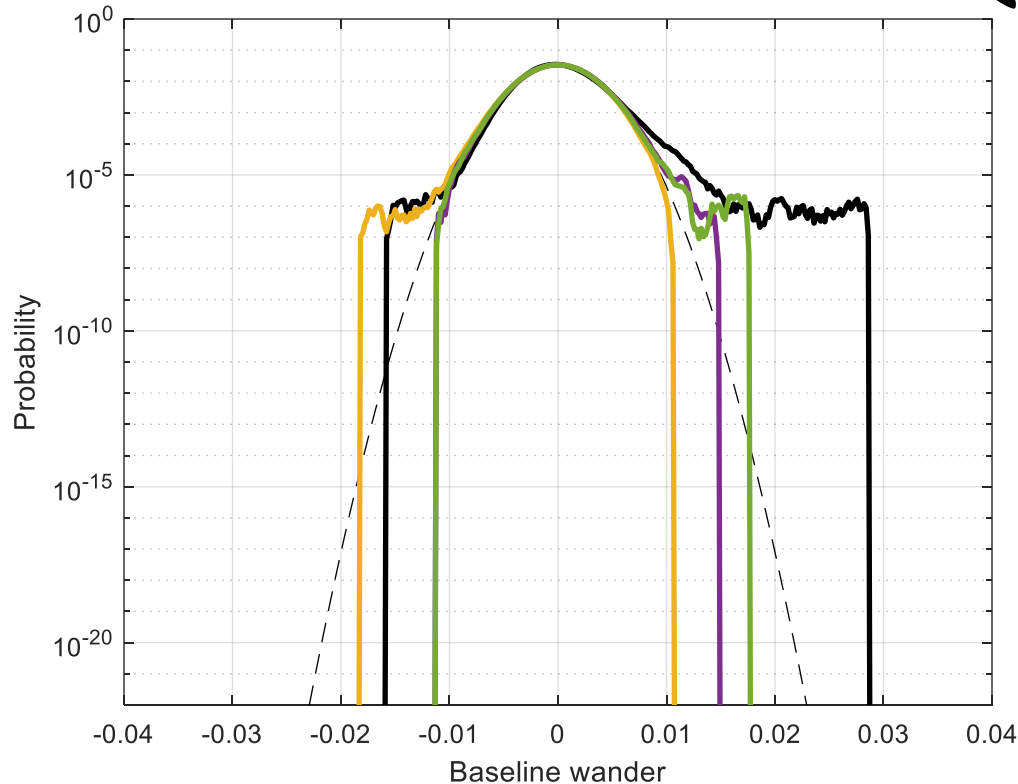
- Black: Not precoded. More challenging than real traffic, best for conservative testing

- Yellow, green and purple: precoded

- Purple is the most representative for baseline wander – best for training

- Also its transition density statistics are somewhat better than un-precoded PRBS31Q

- This is the recommended choice. As it happens, it is also the default, if the PRBS31 is initialised as in 120.5.11.2.2 (seed is all 1s). So define it like this

    – As already stated in the draft, different initializations should be used for different lanes

Conclusion

- An acceptable set of PRBS13Q can be defined by shifting two seeds by one bit

- A unique precoded PRBS31Q can be defined, with better statistical properties for training than regular PRBS31Q
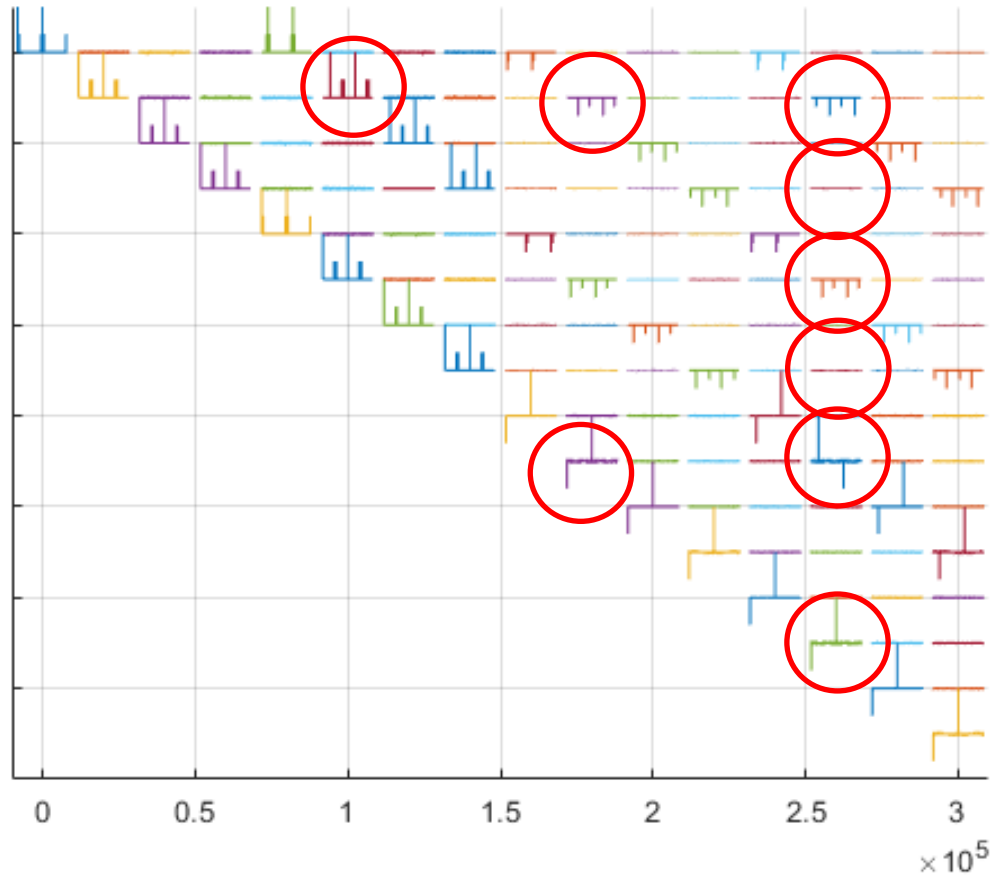
Backup

- The next two slides allow the reader to compare the pattern correlations by flipping between them

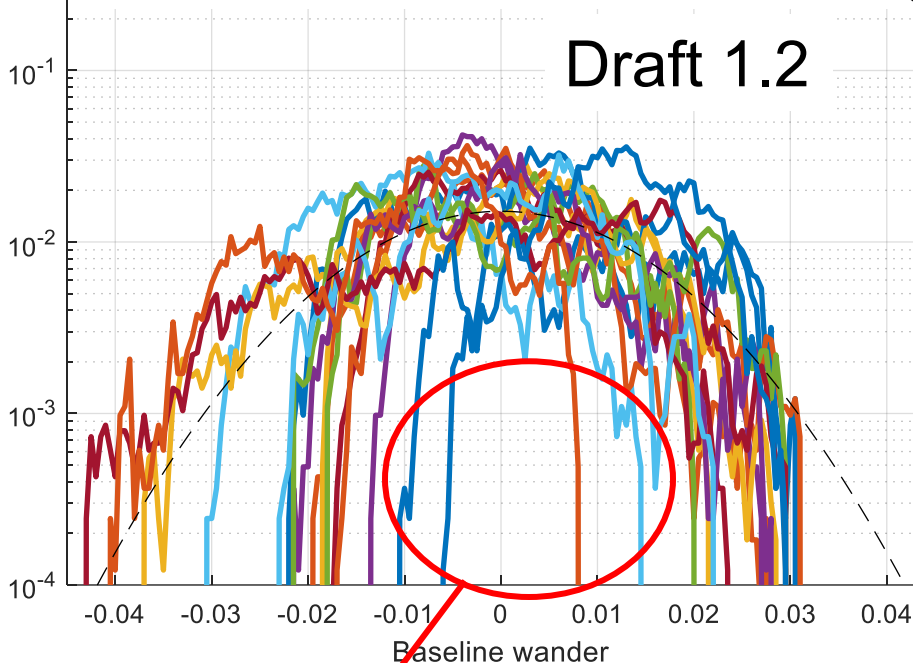- The last slides repeats slide 4 with a a higher high-pass corner frequency

Draft 1.2

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Defining the training patterns
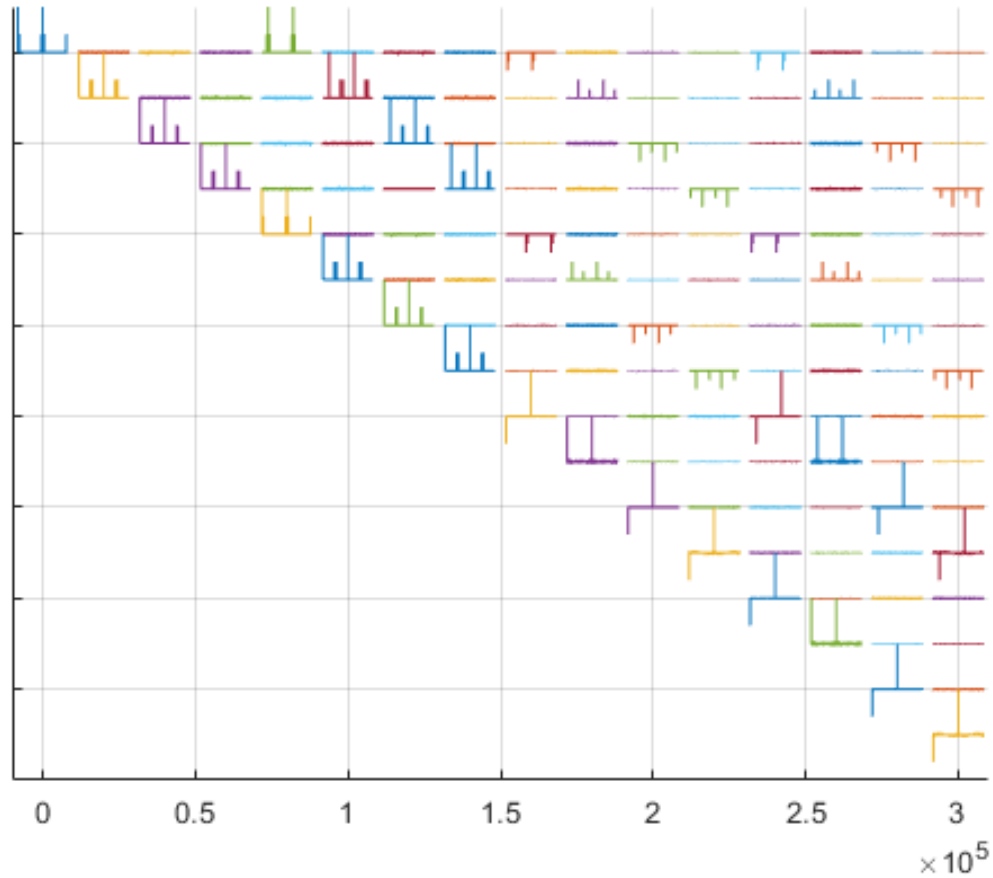
Proposed

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D1.2 PRBS13Q and proposed improvement
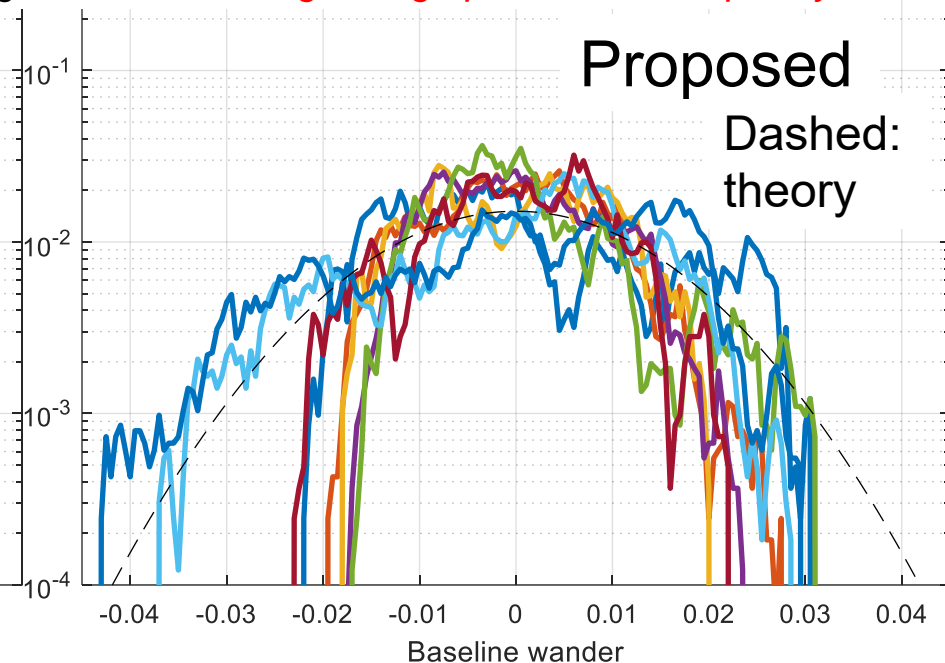
Statistics of the PRBSQ alone, without the training header, with a higher high-pass corner frequency

Draft 1.2

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