Fast simulation and prototyping with AFF3CT

Adrien Cassagne, Olivier Hartmann, Mathieu Léonardon, Thibaud Tonnellier, Guillaume Delbergue, Camille Leroux, Romain Tajan, Bertrand Le Gal, Christophe Jego, Olivier Aumage and Denis Barthou

AFF3CT ?

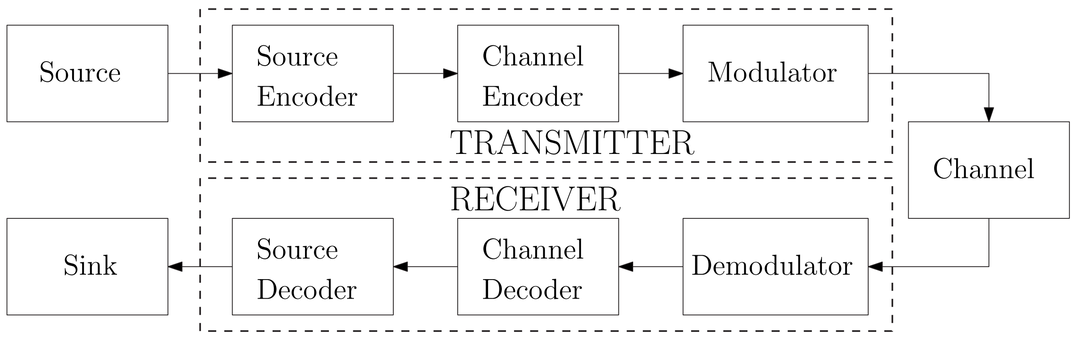

Figure 1 – Simplified digital communication chain.

- dedicated to the simulation of digital communication chain,
- reproduces state-of-the-art simulation results,
- can be used as an external library,
- portable : Windows, MacOSX and Linux; x86 and ARM CPUs,
- written in C++ : parallel, optimized source code (SIMD, multi-threaded, multi-nodes),
- open-source (MIT license): `http://aff3ct.github.io`.

Fast simulation of channel coding

Channel code	Standard	Réf.	Decoder	Fixed point	Throughput (Mb/s)
LDPC	5G, WiMAX, WiFi, DVB-S2, 10GE, etc.	[1, 2]	Sum-Product Min-Sum Gallager	No Yes Yes	5 50 10
Polar	5G	[3, 4, 5]	SC SC-List SCAN	Yes Yes No	1000 500 10
Turbo	LTE (3G, 4G), DVB-RCS, CCSDS, etc.	[6, 7]	Turbo BCJR	Yes	100
BCH	CD, DVD, SSD, DVB-S2, etc.	-	Algebraic	No	100
Convol.	NASA	-	BCJR-MAP BCJR-Linear BCJR-Max	No No Yes	10 50 1000

Table 1 – Non-exhaustive list of supported channel codes / decoders in AFF3CT. Throughputs are given on an indicative basis for 1 physical x86 CPU core (Intel Core i5-5300U @ 2.30GHz).

Plotting results with PyBER

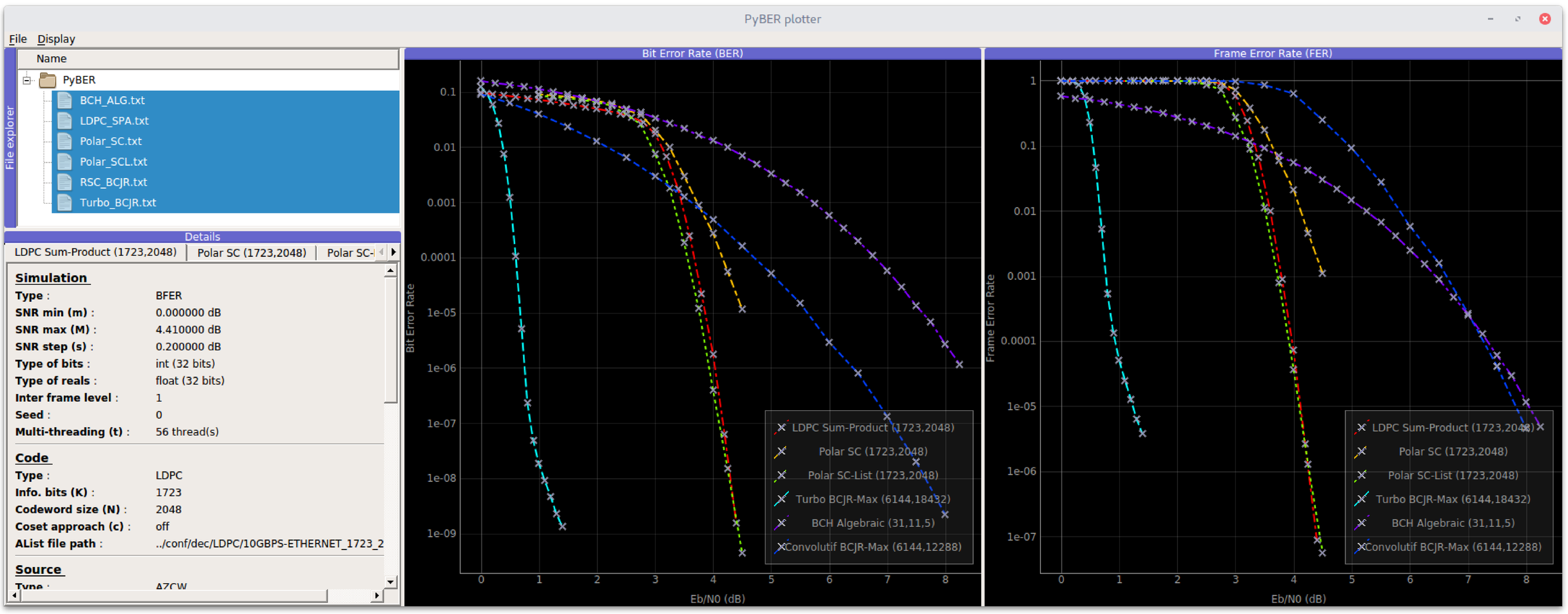

Figure 2 – PyBER is an integrated visualization tool to plot BER/FER in AFF3CT.

Also in AFF3CT

- Modulations : CPM, PSK, QAM, PAM, OOK, SCMA[8],
- Channels : AWGN and Rayleigh,
- SystemC/TLM compatible interfaces for hardware in the loop,
- Multi-node support for execution on supercomputers,
- Generation tools for polar codes.

Conclusion

AFF3CT is a fast and flexible software tool for the simulation and prototyping of digital communication systems. It is open-source, portable and easily integrates in your environement.

Aknowledgement

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References

[1] B. Le Gal and C. Jego. High-throughput multi-core LDPC decoders based on x86 processor. *IEEE TPDS*, 27(5):1373–1386, 2016.

[2] B. Le Gal and C. Jego. High-throughput LDPC decoder on low-power embedded processors. *IEEE Comm. Letters*, 19(11):1861–1864, 2015.

[3] B. Le Gal, C. Leroux, and C. Jego. Multi-Gb/s software decoding of polar codes. *IEEE Transactions on Signal Processing*, 63(2):349–359, 2015.

[4] A. Cassagne, B. Le Gal, C. Leroux, O. Aumage, and D. Barthou. An efficient, portable and generic library for successive cancellation decoding of polar codes. In *Proc. of the Springer LCPC Work.*, 2015.

[5] A. Cassagne, O. Aumage, C. Leroux, D. Barthou, and B. Le Gal. Energy consumption analysis of software polar decoders on low power processors. In *IEEE EUSIPCO*, 2016.

[6] T. Tonnellier, C. Leroux, B. Le Gal, B. Gadat, C. Jego, and N. Van Wambeke. Lowering the error floor of turbo codes with crc verification. *IEEE Wireless Communications Letters*, 5(4):404–407, Aug 2016.

[7] A. Cassagne, T. Tonnellier, C. Leroux, B. Le Gal, O. Aumage, and D. Barthou. Beyond Gbps turbo decoder on multi-core CPUs. In *IEEE ISTC*, 2016.

[8] A. Ghaffari, M. Léonardon, Y. Savaria, C. Jego, and C. Leroux. Improving performance of SCMA MPA decoders using estimation of conditional probabilities. In *IEEE NEWCAS*, 2017.