LDPC codes

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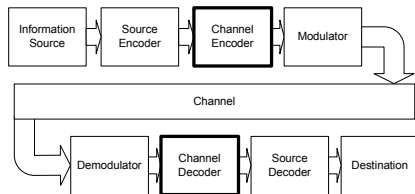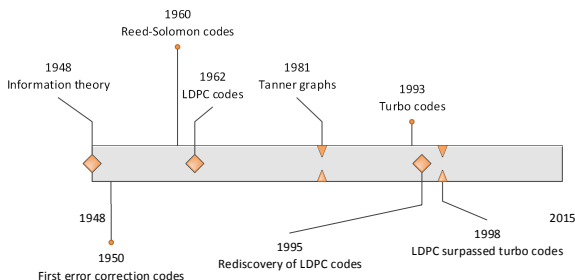
2016

Outline

Coding theory

- Shannon's model

Applications:
- Television broadcasting (DVB-S2)
- Communication networks (WiMAX)
- Deep space data transmission (New Horizons - Pluto)
- Hardware in hardened environment (particle detectors)

# Low Density Parity Check (LDPC) Codes

- Historical milestones in error correction coding

- Current trend - LDPC Codes - best known coding technique
- Design of LDPC codes - regular structures, pseudo-random matrices avoiding cycles in associated graph, genetic optimization
- Evaluation of correcting performance - computationally intensive task - **billions of operations**

Genetic based design - illustrative example

- Problem definition - frame of 64 bit, 8 bits for redundancy, design a code for correcting all single-bit errors with the use of Sum-Product decoding
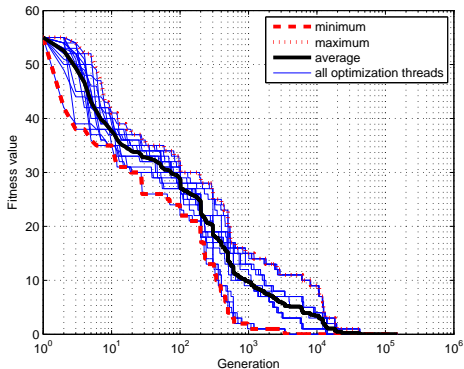
Genetic based design - result

Correction performance			
Corrupted bits	**Error type**	**7 iterations and more**	**3 iterations**
1	Any	100%	93.75%
2	Burst	11.1%	11.1%
2	Any	1.4%	1.4%
3	Any	0.1%	0.1%
3	Burst	9.7%	9.7%
4	Burst	8.2%	8.2%
5	Any	6.7%	6.7%

Detection performance		
1-2	Any	100%
3	Any	99.5%
4	Any	99.6%
2-64	Burst	100%

Comparison of CPU x GPU computing time

CPU (1 core)	GPU	Bits in the frame	Redundancy of the code
28 s	3.2 s	512	50%
7533 s	5.25 s	10240	50%
24414 s	6.60 s	25600	50%

- LDPC codes with Sum-Product decoding considered
- Measuremens performed for the Bit Error Calculation (plot until the value of 10^{-4} is reached)
- GPU calculations based on HybriLIT resources

Bits in the frame	Recalculated speed up
512	8.75 ×
10240	1434 ×
25600	3699 ×

Thank for your attention...

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