

Analysis of the performance of min sum decode algorithm in Gaussian channel for random matrices

Anurag Gupta
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Instructor: Prof Madhav P. Desai

IIT-Bombay
Department of Electrical Engineering



Introduction



- Min sum algorithm is implemented for Gaussian channel.
- Random matrix of block size($n=$) 4K, 8K, 12K and 16K are formed using Mackey's algorithm.
- Five different code rates($R=$) 0.75, 0.80, 0.85, 0.90 and 0.95 are taken.
- Raw input bit error rate(BER(IN)) is between 10^{-2} to 10^{-3} , converted in form of $E_b/N_0(\text{db})$ to express input SNR in db.
- BER(OUT) : Output bit error rate.
- CDB : Number of correctly decoded blocks.
- Itr : Average number of iterations per block.
- We have tabulated simulation by sending 100 blocks and noting BER and number of iteration to decode.
- We have tabulated when the first block get wrongly decoded till 1 million transmitted blocks.

Min Sum Decode (Rate=0.75)



n	BER(In)	Eb/No(db)	BER(OUT)	CDB	ltr(/150)
4096	1.0×10^{-2}	5.5	0	100	2
	4.8×10^{-3}	6.5	0	100	1
	1.8×10^{-3}	7.5	0	100	1
8192	1.0×10^{-2}	5.5	0	100	2
	4.8×10^{-3}	6.5	0	100	1
	1.8×10^{-3}	7.5	0	100	1
12288	1.0×10^{-2}	5.5	0	100	2
	4.8×10^{-3}	6.5	0	100	1
	1.8×10^{-3}	7.5	0	100	1
16384	1.0×10^{-2}	5.5	0	100	2
	4.8×10^{-3}	6.5	0	100	1
	1.8×10^{-3}	7.5	0	100	1

Min Sum Decode (Rate=0.8)



n	BER(ln)	Eb/No(db)	BER	CDB	ltr(/150)
4096	0.8×10^{-2}	5.5	0	100	2
	3.8×10^{-3}	6.5	0	100	1
	1.5×10^{-3}	7.5	0	100	1
8192	0.8×10^{-2}	5.5	0	100	2
	3.8×10^{-3}	6.5	0	100	1
	1.5×10^{-3}	7.5	0	100	1
12288	0.8×10^{-2}	5.5	0	100	2
	3.8×10^{-3}	6.5	0	100	1
	1.5×10^{-3}	7.5	0	100	1
16384	0.8×10^{-2}	5.5	0	100	2
	3.8×10^{-3}	6.5	0	100	1
	1.5×10^{-3}	7.5	0	100	1

Min Sum Decode (Rate=0.85)



n	BER(IN)	E_b/N_0 (db)	BER	CDB	ltr(/150)
4096	1.0×10^{-2}	5	0	100	3
	4.5×10^{-3}	6	0	100	2
	1.7×10^{-3}	7	0	100	1
8192	1.0×10^{-2}	5	0	100	3
	4.5×10^{-3}	6	0	100	2
	1.7×10^{-3}	7	0	100	1
12288	1.0×10^{-2}	5	0	100	3
	4.5×10^{-3}	6	0	100	2
	1.7×10^{-3}	7	0	100	1
16384	1.0×10^{-2}	5	0	100	3
	4.5×10^{-3}	6	0	100	2
	1.7×10^{-3}	7	0	100	1

Min Sum Decode (Rate=0.9)



n	BER(IN)	E_b/N_0 (db)	BER	CDB	l _{tr} (/150)
4096	0.9×10^{-2}	5	0	100	3
	3.6×10^{-3}	6	0	100	2
	1.3×10^{-3}	7	0	100	1
8192	0.9×10^{-2}	5	0	100	3
	3.6×10^{-3}	6	0	100	2
	1.3×10^{-3}	7	0	100	1
12288	0.9×10^{-2}	5	0	100	4
	3.6×10^{-3}	6	0	100	2
	1.3×10^{-3}	7	0	100	1
16384	0.9×10^{-2}	5	0	100	4
	3.6×10^{-3}	6	0	100	2
	1.3×10^{-3}	7	0	100	1

Min Sum Decode (Rate=0.95)



n	E_b/N_0 (db)	BER	CDB	ltr(/150)
4096	-	-	-	-
8192	-	-	-	-
12288	4.5	0.0075	0	-
	5.5	0	100	4
	6.5	0	100	2
16384	4.5	0.0072	0	-
	5.5	0	100	4
	6.5	0	100	2

- $n = 4096$ and 8192 cycle free random matrix was not able to generate.

First error in 1 million blocks



$n \simeq$	$\text{BER}(\ln) \simeq$	$R=0.75$	$R=0.8$
4K	1.0×10^{-2}	1.2799×10^4	2.0754×10^4
	0.5×10^{-3}	5.53727×10^5	1.72781×10^5
	1.0×10^{-3}	-	6.24436×10^5
8K	1.0×10^{-2}	1.92476×10^5	8.3898×10^4
	0.5×10^{-3}	3.21027×10^5	4.6092×10^4
	1.0×10^{-3}	-	-
12K	1.0×10^{-2}	2.20022×10^5	1.57371×10^5
	0.5×10^{-3}	2.17452×10^5	9.0158×10^4
	1.0×10^{-3}	-	-

■ - : No error found till 1 million blocks.

First error in 1 million blocks



$n \simeq$	$\text{BER}(\ln) \simeq$	$R=0.85$	$R=0.9$	$R=0.95$
4K	1.0×10^{-2}	3.39×10^2	1.259×10^3	NA
	0.5×10^{-3}	6.6700×10^4	1.65511×10^5	NA
	1.0×10^{-3}	3.45503×10^5	1.19008×10^5	NA
8K	1.0×10^{-2}	5.193×10^3	5.947×10^3	NA
	0.5×10^{-3}	3.7952×10^4	1.1389×10^4	NA
	1.0×10^{-3}	-	-	NA
12K	1.0×10^{-2}	1.2894×10^4	1.2626×10^4	1.1
	0.5×10^{-3}	1.56487×10^5	5.4866×10^4	1.034×10^4
	1.0×10^{-3}	-	-	1.4759×10^4

- NA : Not Applicable. (Matrix was not formed)
- - : No error found till 1 million blocks.