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

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Introduction

- Min sum algorithm is implemented for Gaussian channel.
- Quasi-cyclic matrix of block size(n=) 4K, 8K and 12K are formed using Sridhara-Fuja-Tanner 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 Eb/No(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	Itr
4112	$3.3 x 10^{-2}$	3.5	0	100	5
	$1.0 x 10^{-2}$	5.5	0	100	2
	$4.8 x 10^{-3}$	6.5	0	100	1
	$1.8 x 10^{-3}$	7.5	0	100	1
8180	$2.9 x 10^{-2}$	3.8	0	100	5
	$1.0 x 10^{-2}$	5.5	0	100	2
	$4.8 x 10^{-3}$	6.5	0	100	1
	$1.8 x 10^{-3}$	7.5	0	100	1
12304	$3.4 x 10^{-2}$	3.4	0	100	6
	$1.0 x 10^{-2}$	5.5	0	100	2
	$4.8 x 10^{-3}$	6.5	0	100	1
	$1.8 x 10^{-3}$	7.5	0	100	1

Min Sum Decode (Rate=0.8)

n	BER(In)	Eb/No(db)	BER	CDB	Itr(/25)
4075	$2.2x10^{-2}$	4.1	0	100	4
	$0.8x10^{-2}$	5.5	0	100	2
	$3.8x10^{-3}$	6.5	0	100	1
	$1.5x10^{-3}$	7.5	0	100	1
8275	$2.4x10^{-2}$	3.9	0	100	5
	$0.8x10^{-2}$	5.5	0	100	2
	$3.8x10^{-3}$	6.5	0	100	1
	$1.5x10^{-3}$	7.5	0	100	1
12275	$2.5x10^{-2}$	3.8	0	100	6
	$0.8x10^{-2}$	5.5	0	100	2
	$3.8x10^{-3}$	6.5	0	100	1
	$1.5x10^{-3}$	7.5	0	100	1

Min Sum Decode (Rate=0.85)

n	BER(IN)	Eb/No(db)	BER	CDB	Itr(/25)
4220	$1.9x10^{-2}$	4	0	100	6
	$1.0x10^{-2}$	5	0	100	3
	$4.5x10^{-3}$	6	0	100	2
	$1.7x10^{-3}$	7	0	100	1
8180	$1.9x10^{-2}$	4	0	100	6
	$1.0x10^{-2}$	5	0	100	3
	$4.5x10^{-3}$	6	0	100	2
	$1.7x10^{-3}$	7	0	100	1
12260	$1.9x10^{-2}$	4	0	100	6
	$1.0x10^{-2}$	5	0	100	3
	$4.5x10^{-3}$	6	0	100	2
	$1.7x10^{-3}$	7	0	100	1

Min Sum Decode (Rate=0.9)

n	BER(IN)	Eb/No(db)	BER	CDB	Itr(/25)
4120	$1.1x10^{-2}$	4.7	0	100	4
	$0.9x10^{-2}$	5	0	100	3
	$3.6x10^{-3}$	6	0	100	2
	$1.3x10^{-3}$	7	0	100	1
8440	$1.2x10^{-2}$	4.5	0	100	5
	$0.9x10^{-2}$	5	0	100	3
	$3.6x10^{-3}$	6	0	100	2
	$1.3x10^{-3}$	7	0	100	1
12280	$1.2x10^{-2}$	4.5	0	100	5
	$0.9x10^{-2}$	5	0	100	3
	$3.6x10^{-3}$	6	0	100	2
	$1.3x10^{-3}$	7	0	100	1

Min Sum Decode (Rate=0.95)

n	BER(IN)	Eb/No(db)	BER	CDB	Itr(/25)
4260	$1.1x10^{-2}$	4.5	$6.8x10^{-3}$	23	-
	$4.7x10^{-3}$	5.5	0	100	3
	$1.6x10^{-3}$	6.5	0	100	2
8220	$1.1x10^{-2}$	4.5	$7.5x10^{-3}$	8	-
	$4.7x10^{-3}$	5.5	$2.8x10^{-7}$	99	-
	$1.6x10^{-3}$	6.5	0	100	2
12660	$1.1x10^{-2}$	4.5	$7.2x10^{-3}$	4	-
	$4.7x10^{-3}$	5.5	0	100	4
	$1.6x10^{-3}$	6.5	0	100	2

First error till 1 million blocks

n≃	BER(ln)≃	R=0.75	R=0.80
4K	$1.0 x 10^{-2}$	-	-
	$0.5 x 10^{-3}$	-	-
	$1.0 x 10^{-3}$	-	-
8K	$1.0 x 10^{-2}$	-	-
	$0.5 x 10^{-3}$	-	-
	$1.0 x 10^{-3}$	-	-
12K	$1.0 x 10^{-2}$	-	-
	$0.5 x 10^{-3}$	-	-
	$1.0 x 10^{-3}$	-	-

- - : No error found till 1 million blocks.

First error till 1 million blocks

n≃	BER(In)≃	R=0.85	R=0.9	R=0.95
4K	1.0×10^{-2}	2.677×10^{3}	1.7819×10^{4}	1
	0.5×10^{-3}	2.4944×10^{4}	1.65511×10^{5}	1.79×10^{2}
	1.0×10^{-3}	5.47550×10^{5}	4.89654×10^{5}	3.328×10^{3}
8K	1.0×10^{-2}	2.3817×10^{4}	1.16847×10^{5}	1
	0.5×10^{-3}	6.9491×10^{4}	1.72263×10^{5}	1.001×10^{3}
	1.0×10^{-3}	9.16505×10^{5}	6.28939×10^{5}	9.338×10^{3}
12K	1.0×10^{-2}	9.705×10^{3}	5.37754×10^{5}	1
	0.5×10^{-3}	5.6400×10^{4}	-	1.318×10^{3}
	1.0×10^{-3}	-	-	1.6920×10^{4}

- - : No error found till 1 million blocks.