

Results

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1 a - τ separated input weight 2 error events

For an RSC encoder, input weight 2 error events with the "1" bits separated by a multiple of the cycle length, τ (a - τ separated input weight 2 error events) tend to produce low-weight codewords. Therefore in turbo codes employing RSC encoders as component codes, when these error events are present in both component codes, a low-weight turbo codeword is produced.

In the analysis of distance properties of the interleaver we assume that only τ -separated input weight 2 events present in both component encoders are sufficient to determine the effective free distance of the turbo code. We then confirm the validity of this assumption by considering all input weight 2 error events.

For the interleaver defined by

$$\Pi_{\pi}(i) \equiv Di \pmod{N}, \quad 0 \leq i \leq N, \quad \gcd(N, D) = 1 \quad (1)$$

Table 1: Effective Free Distance calculations for RSC 5/7 , $\tau = 3$, $N = 2^{10}$

D	t=at & s=bt	t=at & s=[1 N]	t=[1 N] & s=[1 N]
9	26	26	11
27	62	51	23
63	134	47	47
45	74	51	35
81	90	47	35
99	110	39	27
108	52	47	32
117	82	31	31
153	114	47	27
171	22	11	11
189	90	35	35
207	38	38	24
243	110	31	31
261	54	39	34
279	198	34	15
297	82	47	31
333	102	23	23
351	70	27	27
369	74	47	27
387	70	39	27
423	86	43	39
459	94	35	35
477	146	23	23

Table 2: Effective Free Distance calculations for RSC 5/7 , bit positions, $\tau = 3$, $N = 2^{10}$

D	Effective free distance	bit positions(t)	[bit positions] (s)
9	11	(1022 1023) (1023 1024)	(998 1007) (1007 1016)
18	17		
27	23		
36	29		
45	35		
54	30		
63	47		
72	49		
81	35		
99	27		
108	32		
117	31		
126	53		
144	47		
153	27		
162	21		
171	11		
189	35		
198	29		
207	24		
216	38		
234	33		
243	31		
252	46		
261	34		
279	15		
288	27		
297	31		
306	19		
324	25		
333	23		
342	9		
351	27		
369	27		
378	43		
387	27		
396	33		
414	38		
423	39		
432	41		
441	19		

D	Effective free distance	bit positions(t)	[bit positions] (s)
459	35		
468	44		
477	23		
486	29		
504	42		