Supplementary information for paper "Using Constraint Solvers to Construct Binary Codes with Good Error Correction Performance"

This document contains additional information on computational experiments and the extended table containing the results used to draw Figure 2 in the original manuscript.

Magma

In order to obtain a code from the Magma system, we used the online calculator available at `https://magma.maths.usyd.edu.au/calc/`. To get the generator matrix of a binary linear block (n, k, d) we used the following command:

```
C:=BKLC(GF(2),N, K)
C
```

Then we saved the resulting matrix into a gen file and processed it in a standard manner.

QextNewEdition

The program is available at `https://www.moi.math.bas.bg/moiuser/~data/Software/QextNewEdition.html`. It uses algebraic methods to generate nonequivalent linear codes with fixed parameters. It has quite peculiar user interface, and we used it as follows:

1. In the main menu, enter 2.
2. "Enter n = " : enter the value of n;
3. "Enter k = " : enter the value of k;
4. "Enter d =" : enter the value of d;
5. "Enter q =" : enter 2;
6. "Weights are divisible by dw =" : enter 1;
7. "Self orthogonal 1-Yes / 0-No" : enter 0;
8. In the main menu, enter 1.

Cube-and-Conquer

We used the Cube-and-conquer in a more or less standard fashion:

1. Split each SAT instance into at most 10 000 subinstances by giving to march_cu the cutoff threshold via -n *threshold*. The value of the threshold was found by a straightforward script.

2. Invoke Kissat on these subinstances with the time limit of 5 000 seconds.

3. Terminate all running jobs upon finding a satisfying assignment on any subinstance.

Results for 51 codes

Table 1 contains the best found error coefficients T of all 51 considered (n, k, d)-codes found by all methods. Runtimes for Qext and Magma are not presented because Qext does not report the corresponding information, while obtaining any code from Magma's database takes a negligible time. For MaxSAT and CP-SAT we report the time of finding the respective solution, while the actual runtime was limited by 24 hours.

n	Kissat_SB	SPB_noSB	SPB_SB	CPSAT_noSB	CPSAT_SB	Qext	Magma
				$k = 8$			
34	90 / 6 s	62 / 2 h	62 / 3 h	60 / 3 h	62 / 2 h	**40**	68
35	**68** / 1 m	-	**68** / 6 m	**68** / 7 h	**68** / 1 h	**68**	**68**
36	**153** / 18 s	-	**153** / 4 m	**153** / 8 h	**153** / 3 h	**153**	**153**
37	124 / 4 s	-	**69** / 6 h	**69** / 22 h	121 / 22 h	**69**	125
38	82 / 7 s	**48** / 11 h	51 / 1 h	69 / 17 h	**48** / 1 h	53	129
39	84 / 3 s	22 / 9 h	20 / 3 h	**16** / 5 h	32 / 3 h	76	99
40	66 / 1 s	8 / 19 h	10 / 8 h	**6** / 12 h	13 / 1 h	32	99
41	38 / 9 m	-	-	**26** / 8 h	28 / 6 h	29	32
42	82 / 7 m	-	**70** / 3 h	71 / 11 h	78 / 4 h	75	80
43	63 / 7 s	31 / 8 h	30 / 6 h	**19** / 19 h	43 / 4 h	-	69
44	60 / 2 m	-	**47** / 11 h	55 / 16 h	54 / 7 h	48	60
45	133 / 3 m	-	128 / 2 h	-	130 / 3 h	**125**	133
46	108 / 5 m	-	**55** / 16 h	94 / 6 h	99 / 17 h	89	111
47	**66** / 12 m	-	-	-	-	**66**	**66**
48	**144** / 5 m	-	-	-	-	**144**	**144**
49	70 / 1 h	-	-	-	-	-	**44**
50	96 / 7 m	-	-	-	-	**56**	96
				$k = 10$			
34	90 / 3 s	**43** / 15 h	46 / 21 h	65 / 6 h	52 / 23 h	-	236
35	79 / 2 s	21 / 10 h	17 / 9 h	**16** / 22 h	23 / 6 h	53	180
36	56 / 1 h	-	-	**54** / 6 h	55 / 9 h	-	64
37	**149** / 5 h	-	-	-	-	-	160
38	107 / 15 s	**78** / 4 h	85 / 3 h	87 / 22 h	87 / 17 h	-	153
39	**113** / 14 m	-	-	-	115 / 23 h	-	115
40	287 / 1 h	-	-	-	-	-	**286**
41	222 / 26 m	-	-	**217** / 13 h	**217** / 3 h	-	220
42	128 / 3 m	-	**104** / 6 h	107 / 13 h	106 / 11 h	118	210
43	95 / 6 s	52 / 3 h	**44** / 24 h	57 / 21 h	67 / 10 h	-	225
44	-	-	-	-	-	-	**72**
45	-	-	-	-	-	-	**185**
46	**136** / 7 h	-	-	-	-	-	158
47	-	-	-	-	-	-	**138**
48	-	-	-	-	-	-	**330**
49	261 / 19 m	-	-	-	-	-	**263**
50	204 / 1 h	-	-	-	-	-	**267**
				$k = 12$			
34	**576** / 16 h	-	-	-	-	-	**576**
35	-	-	-	-	-	-	**422**
36	**206** / 27 m	-	-	212 / 11 h	207 / 14 h	-	425
37	143 / 1 m	138 / 24 h	144 / 20 h	137 / 3 h	**122** / 13 h	**122**	431
38	-	-	-	-	-	-	**112**
39	-	-	-	-	-	-	**356**
40	-	-	-	-	-	-	**356**
41	182 / 30 m	-	-	-	190 / 22 h	-	**160**
42	-	-	-	-	-	-	**219**
43	-	-	-	-	-	-	**579**
44	**430** / 10 h	-	-	-	-	-	580
45	**340** / 16 h	-	-	-	-	-	577
46	159 / 17 m	-	-	144 / 23 h	**138** / 15 h	-	161
47	123 / 1 m	**48** / 12 h	147 / 24 h	111 / 1 h	87 / 24 h	-	469
48	-	-	-	-	-	-	**128**
49	-	-	-	-	-	-	**321**
50	-	-	-	-	-	-	**322**

Table 1: Error coefficients of (n,k,d)-codes found by all methods and the respective runtimes. The best results are marked with bold.