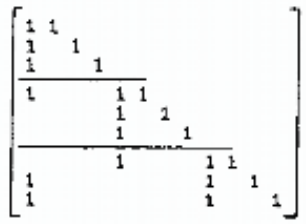

Fig. 2. Check matrix A_N of (4,1) code with $u = 1$.

Consider a type-$B2$ burst of $r = u + 1$ consecutive blocks. If the burst starts in the first block, then it would span from e_0^1 to e_u^n. Furthermore, assume that the burst contains no more than t errors. If e_0^1 is error free, then at most t of the equations of (26) are affected by the errors of the burst since each of the digits $e_0^2, e_0^3, \cdots, e_u^n$ appears at most once in (26). For the same reason, if e_0^1 is erroneous, no more than $t - 1$ of the equations of (26) are affected by the remaining errors of the burst. Hence, Theorem 1 is satisfied. On the other hand, if the burst starts in the second block, then it would span from e_1^1 to e_{u+1}^n. The first block of n digits $e_0^1, e_0^2, \cdots, e_0^n$ is now error free, and at least the first t equations of (26) $s_0^2, \cdots, s_0^n$ are not affected by the errors of the burst. Thus Theorem 1 is again satisfied. Hence, this class of codes can correct a type-$B2$ burst of $r = u + 1$ blocks and weight no greater than t using majority-logic decoding.

As an example, let $t = 3$ and choose $u = 1$. This is a (4,1) code whose check matrix A_N is shown in Fig. 2. This code can correct any type-$B2$ burst of two blocks (burst length $b_2 = 8$) and weight 3 or less.

The effectiveness of a low-density burst-correcting code has already been discussed in another paper [7]. In particular, on a renewal type of channel it is generally more than 90 percent more effective than a code that is designed to correct burst errors of any weight. According to the Wyner and Ash bound [6], a $(t + 1, 1)$ code that can correct any type-$B2$ burst of $u + 1$ blocks would require at least $u \cdot t + 2 \cdot (t + u + 1)$ rows in A_N; i.e.,

$$N \geq t \cdot (u + 2) + 2 \cdot (u + 1). \tag{27}$$

On the other hand, a $(t + 1, 1)$ low-density correcting code constructed by the method given in this section requires only $N = t \cdot (u + 2)$. Thus this class of codes requires shorter constraint lengths than the "optimal" type-$B2$ codes. For example, the code given in Fig. 2 requires a block constraint length of three, whereas an optimal type-$B2$ code would require five. On examining the set of equations (26), it is also clear that this class of codes can correct many patterns of random errors other than type-$B2$ bursts of weight t or less.

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Correction to "Extended Varshamov–Gilbert and Sphere-Packing Bounds for Burst-Correcting Codes"

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In the above correspondence[1], in the right column on page 291, the fifth line under the Asymptotic Result should have read

$$\leq \exp_2 \left[nH\left(\frac{w-2}{n}\right)\right] + 2^{b-1}, \qquad w \neq 2, \quad 2w < b + 3$$

where $\exp_2 [x]$ means 2^x.

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An Upper Bound for Self-Dual Codes

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Let $\mathscr{C}$ be a binary $[n,k,d]$ linear self-dual ($\mathscr{C} = \mathscr{C}^\perp$) code, in which the weight of every codeword is a multiple of four. Let b be any constant. Then it can be shown that there exists an $n_0(b)$ such that, for all $n > n_0(b)$, $d < (n/6) - b$. Similarly, for a self-dual code over $GF(3)$, for all $n > n_0(b)$, $d < (n/4) - b$. Details will be published elsewhere [1].

References

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Pseudo-Randomness Properties of Binary Shift Register Sequences

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***Abstract*—The M-tuple weight distribution and high-order autocorrelations of binary m-sequences are related to the weight distribution of the shortened Hamming code, which is dual to the m-sequence code. It is shown that good weight distribution and correlation properties can be achieved simultaneously only if the m-sequence is sufficiently long.**

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