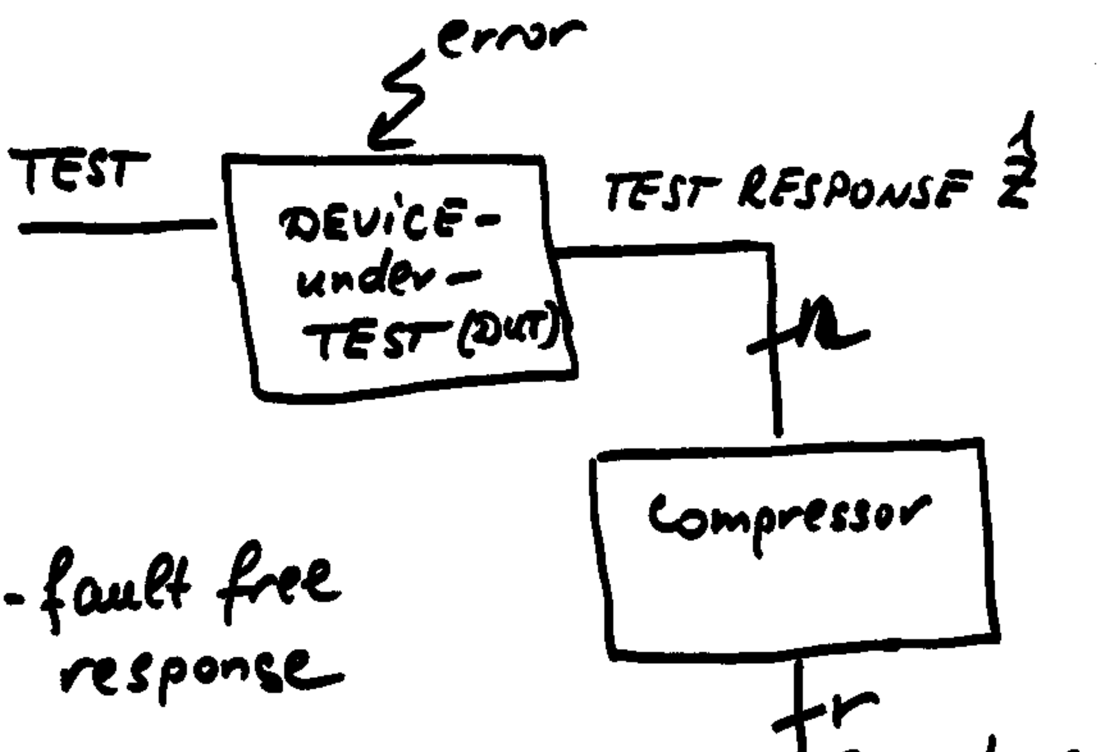
DATA COMPRESSION OF TEST RESPONSES IN COMPUTATION channels by Error Detecting Codes



z - fault free response

$\hat{z}$ - faulty response

$\hat{z} = z \oplus e$ — error

signature analysis

<u>Problem</u>: minimize r (number of observation points, length of the signature to be stored) for a given class E of errors which may appear at the output of the DUT such that
for any z : $\boxed{S(z+e) \neq S(z)}$.

<u>Solution</u>: Let V is an $(n, 2^k, d)$ code and E class of errors with multiplicities at most $d-1$

$(E = \{e \mid \|e\| \le d-1\})$

Let H is a check matrix for V

Then $H\hat{z} = Hz + He \qquad \|e\| \le d-1$

Since V has distance d

$He \neq 0$. Thus $H\hat{z} = Hz$

and we can take

$$S(\hat{z}) = H\hat{z}.$$

- Optimal compressors are networks computing syndromes for the corresponding optimal codes.
- Optimal compressors are <u>linear</u> (can be built by XOR gates only)
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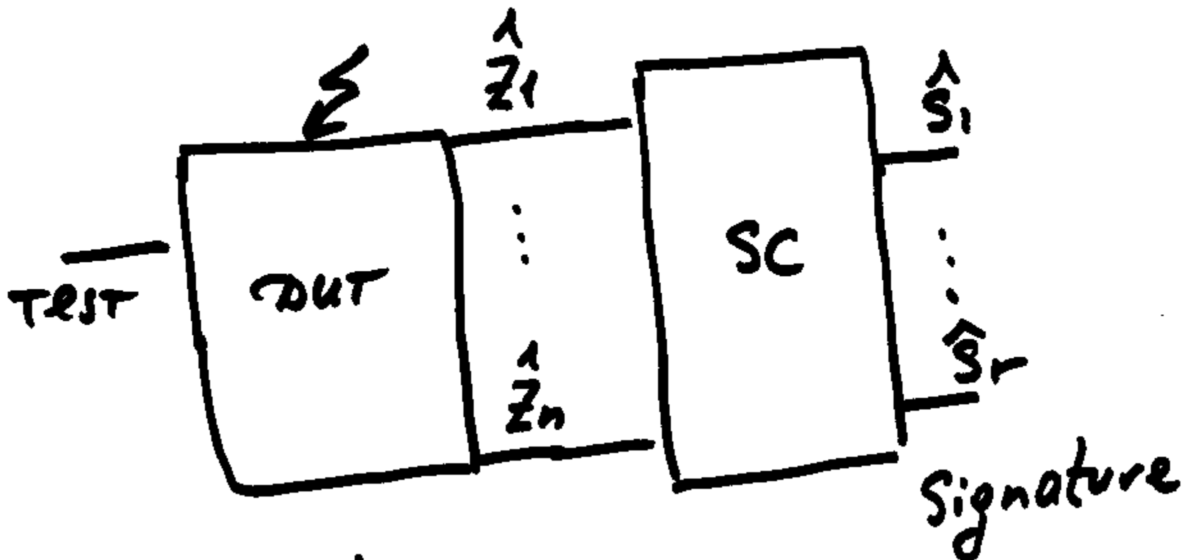
- minimal numbers of observation points are equal to the minimal numbers of redundand bits $r = n - k$ in the corresponding codes
- Compressors compute syndromes of errors
- Good codes generate good compressors with min r.

Space Compressors (SC)



$\hat{S} = H\hat{Z}$

SC is a combinational network of XOR gates computing $\hat{S} = H\hat{Z}$

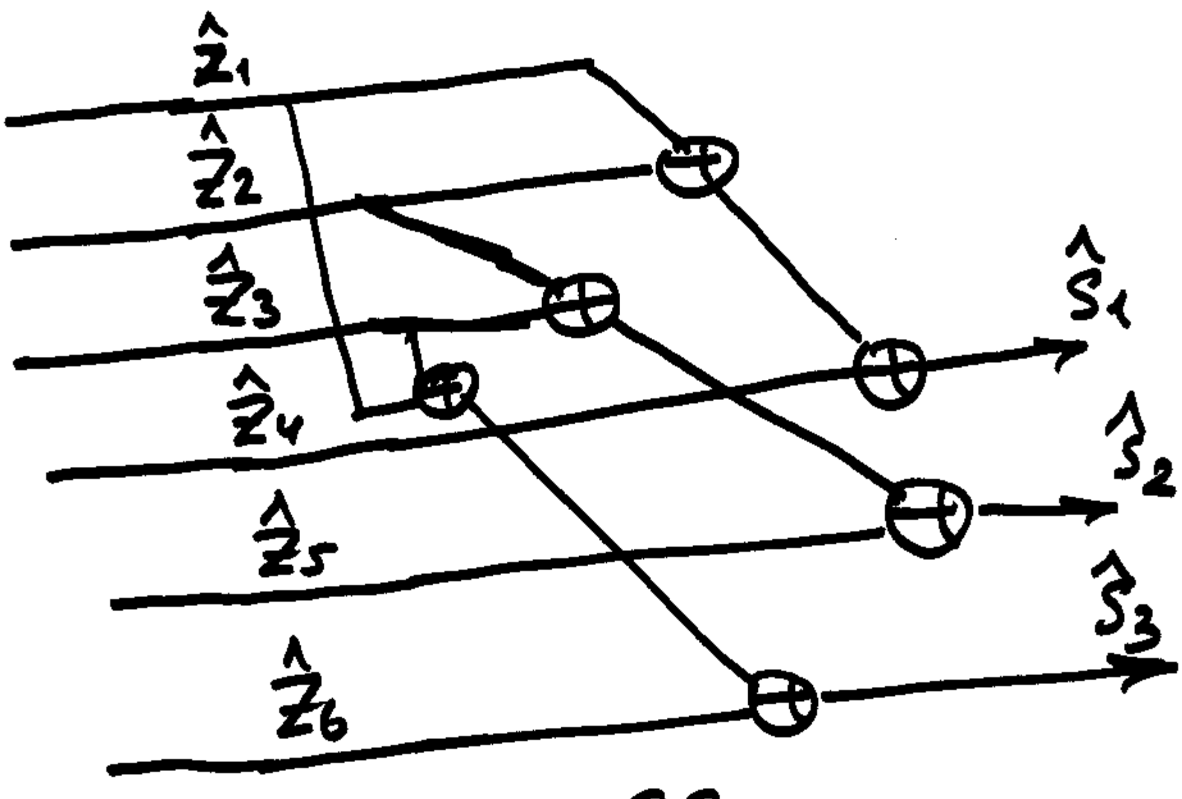
Example SC for **single errors** and **double errors** based on Hamming codes

$l = 2 \qquad r = \lceil \log_2 (n+1) \rceil$

Let $n = 6$

$$G = \begin{bmatrix} 1&0&0&1&0&1 \\ 0&1&0&1&1&0 \\ 0&0&1&0&1&1 \end{bmatrix} \Rightarrow H = \begin{bmatrix} 1&1&0&1&0&0 \\ 0&1&1&0&1&0 \\ 1&0&1&0&0&1 \end{bmatrix}$$

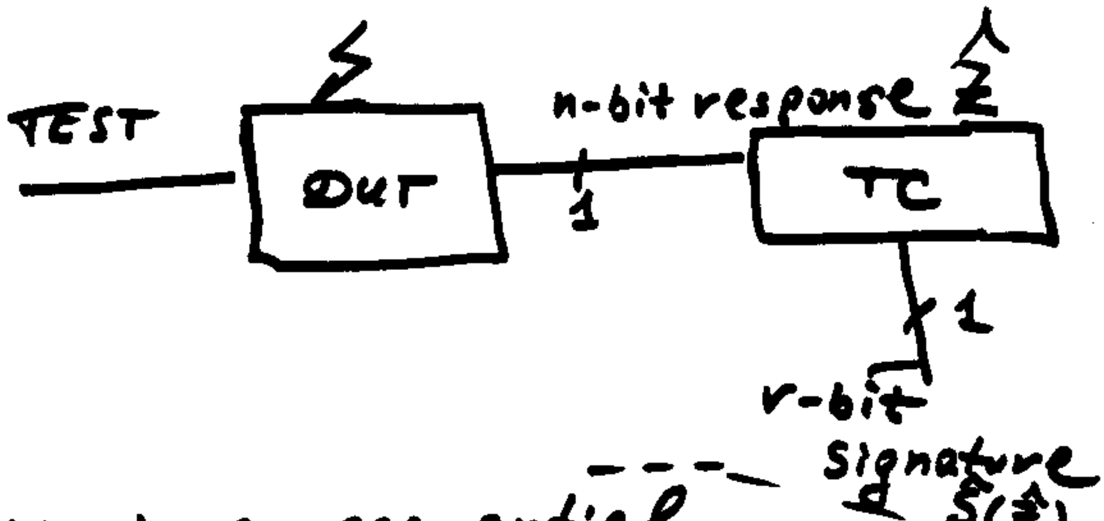
$r = 3$



SC

TIME COMPRESSORS (TC)

TC may be used after SC



. TC is a sequential network computing $\hat{S}(\hat{z})$ in n-clocks

$$\hat{S}(\hat{z}) = H\hat{z}$$

- at most l bits in any n-bit response can be distorted
- $\hat{S}(\hat{z}) \neq S(z)$