ON THE PRINCIPAL STATE METHOD FOR RUNLENGTH LIMITED SEQUENCES.

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Abstract.
We present a detailed result on Franaszek's principal state method for the generation of runlength constrained codes. We show that, whenever the limit as each run of zeros is transmitted over the channel are those containing runs of zeros of length \( d \), \( d < k \). These channels can be described by a state model framework, and thus it is at least as efficient as any other code. A runlength constrained code, \((d, k)\)-constrained code, is a binary encoding of information that such as the one used in the state model framework and, thus, it is at least as efficient as any of the glue methods, since the glue methods can also be described in the state model framework.

The principal states.

Our goal
We start with the definition of the building blocks or basic sets \( U(m) \) for the codeword sets given the \((d,k)\)-constraint, containing all sequences that start and end with a "one" and satisfy the \((d,k)\)-constraint internally. Let \( U(m) \) denote the size of \( U(m) \).

In the following we shall repeatedly use the shorthand notation \( [a;b] \triangleq \{a,a+1,\ldots,b\} \). Let \( S \subset [0;4] \) denote the set of permitted channel states, (not necessarily the set of principal states). Consider the sets \( V_S(n;i) \) containing all sequences starting with a run of zeros and ending in a run of zeros of 

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\begin{align*}
W_S(n;i) &= \bigcup_{0 \leq j \leq \min(n,k-1)} V_S(n;i+j) \cup \{0^j\}, \\
& \quad \text{for } i \in S \text{ and ending in any state } j \in S.
\end{align*}
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Now we can formulate our goal and the result:
Given \( n, k \), and \( d \), (with the restriction \( n \geq k \geq 2d > 0 \)), find the set \( S^* \subset [0;4] \) such that:

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Introduction.
Shannon [4] considers the \((d,k)\)-constrained channel, where the only possible binary sequences that can be transmitted over the channel are those containing runs of zeros of length \( d \), \( d < k \). These channels can be described by a state model framework, and thus it is at least as efficient as any other code. A runlength constrained code, \((d, k)\)-constrained code, is a binary encoding of information that such as the one used in the state model framework and, thus, it is at least as efficient as any of the glue methods, since the glue methods can also be described in the state model framework.

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The principal state method is an optimal code for systems that can be described in the state model framework, and thus it is at least as efficient as any other code. A runlength constrained code, \((d, k)\)-constrained code, is a binary encoding of information that such as the one used in the state model framework and, thus, it is at least as efficient as any of the glue methods, since the glue methods can also be described in the state model framework.

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