**Description of the transform**

**Set Shaping Theory**

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Set Shaping Theory studies the bijection functions that transform a set of strings of length *N* into a set of strings of length *N+K* with K and and .

is the set that contains all the sequences of length N that can be generated from an alphabet A, therefore .

Of particular interest are the functions in which the set contains the strings with less information content belonging to the set .

The transform used in Matlab programs has the purpose of executing the f(x)=y in which y belongs to the set which contains the strings with less information content belonging to the set .

To understand this transformation, we must ask ourselves how we can estimate the average information content of the set . The simplest way is to simulate NH sequences belonging to and select from these the NH/|A| sequences with less entropy. The transform does something very similar it takes the sequence to be encoded and generates |A| new sequences. A parameter is added to these new sequences, so the length of the sequence increases by one (let's consider the case with K=1). Of this |A| new sequences the sequence with less information content represents a sequence belonging to , so we have performed our transform.

The best way to explain this transform is through an example:

Given a sequence of length 10 containing 4 symbols, so and |A| = 4.

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We call the element in position n of the sequence, consequently we have:

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The transform is a parameterized function of this type:

This function generates values belonging to the alphabet A, in the case of example . mod is the function in Matlab that calculates the module, unif is a function that generates values belonging to A with uniform distribution. This function is parameterized with the parameter p belonging to A and therefore can assume |A| different values.

In Matlab programs the unif function used is randsrc(1, len, [symbols; prob], p) with uniform prob and symbols belonging to A, instead the parameter p represents the seed with which to initialize the function. This function generates uniform values belonging to the alphabet A.

In this way, the sequence is transformed into |A| different sequences of length n+1 each with a different p-value. The length of the sequence increases because the p parameter must be added to the sequence so that the decoder can apply the reverse transform.

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Among these |A| different sequences, we choose the sequence that is encoded with fewer bits.

To the decoder will be sent the chosen coded sequence plus the list of codewords (we are using Huffman coding).

The decoder decodes the message obtaining the transformed sequence of length n+1. Finally, it reads the last value of the sequence that corresponds to the value of the parameter p of the sequence with the shortest encoding length and performs the inverse transform obtaining the initial sequence. We call pm the value of the sequence parameter with the shortest encoding length, so we have:

In this way, we get the initial sequence.