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Enactment Evaluation of Discrete Sine Transform (DST) for Blood Pressure Signal Compression in Salt Sensitive Dahl Rat

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Abstract

In this work, Blood Pressure (BP) Signal Compression in Salt Sensitive Dahl Rat has been done using Discrete Sine Transform (DST). In order to keep the user specified percentage root mean square difference (UPRD) within the tolerance, first transform coefficients are thresholded by bisection algorithm. The binary look up tables is used to store the position map for zero and non-zero coefficients (NZC). After quantization of NZC, it is compressed with Arithmetic coding is used to encode the quantized NZC. The analysis includes the dissimilar characteristics of blood pressure signals and found that compression ratio is directly proportional to the user define PRD (UPRD).

Keywords: Blood Pressure signal in Salt Sensitive Dahl Rat; Compression; Discrete Sine Transform (DST).

INTRODUCTION

Signal Compression can be categorized into following ways: (1) lossless and (2) lossy. In lossless technique, the signal samples are encoded in such a way that on

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reconstruction of compressed signal, the recovered signal is the exact replica of original signal. In lossy technique, some signal lose may be acceptable up to that limits that will not greatly affect the basic characteristic of reconstructed signal. In this signal is quantized and encode with arithmetic coding. In this work the used algorithm have both lossy and lossless features.

The presented study revealed on discrete sine transform (DST) based method to compress the BP signals regarding Dahl salt-sensitive rat model as it is an extensively studied model of human salt-sensitive hypertension [1]. For the profound investigation of compressed BP signal these signals must be traced for long time duration.

METHODOLOGY

In this study, DST is used for quality controlled compression of the BP signals. A total of thirty BP signal samples of 1-minute duration that belongs to two genetic categories of rat: the salt sensitive (SS) and salt sensitive chromosome 13 Brown Norway (SS.13BN); separately on high and low salt diet are used. This data set has been taken from Physionet database [2].

DST is used for signal transformation, where transform coefficients are thresholded using bisection algorithm to match the predefined user-specified percentage root mean square difference (UPRD). Huffman coding [3] is used to encode the lookup tables that record the position map of zero and non-zero coefficients (NZCs). The Max-Lloyd quantizer, quantize NZCs followed by Arithmetic coding [4-12]. Performance is evaluated on the basis of Compression ratio (CR) and percentage of root mean square difference (PRD) [4-12]. Visualization of DST for BP signal can done between original and reconstructed signal by selecting ssbn13hs01 at UPRD 0.5 and 2.0.

RESULT AND DISCUSSION

It is observed from the study that CR is inversely proportional to the signal quality. In DST, CR increases from 2.6932 to 11.7706 with an increase in UPRD from 0.5 to 2.0 (Table 1). It is also observed that for UPRD 0.5 to 2.0, mean value for BPRD and QPRD is same (Table 1). However, percentage of error increases with an increase in UPRD at the tune of 2.0 (Figs. 1-2). The percentage difference between the CR with Fractional Fourier Transform (FRFT) [13] and DST is 35.80%, 84.59%, 111.26% and 126.40% for varying UPRD 0.5, 1.0, 1.5 and 2.0 respectively. The visual representation of original and reconstructed signals along with error signal is shown in figure (1-2).

Table. 1. Comparison of DST and FRFT for blood pressure signal of the Model.

Duration= 1 min; quantization bits= 12												
BP signals	[1]UPRD=0.5			[1]UPRD=1			[1]UPRD=1.5			[1]UPRD=2		
	[2]BPRD	[3]QPRD	[4]CR	[2]BPRD	[3]QPRD	[4]CR	[2]BPRD	[3]QPRD	[4]CR	[2]BPRD	[3]QPRD	[4]CR
Mean value (FRFT) [13]	0.5006	0.5006	1.8753	0.9999	0.9999	2.1227	1.4961	1.4961	2.3715	1.9989	1.9989	2.6538
Mean value (DST)	0.4999	0.5001	2.6932	0.9992	0.9993	5.2344	1.4997	1.4997	8.3186	1.9985	1.9985	11.7706

Notes: [1]UPRD = user defined PRD

[2]BPRD = PRD before quantization

[3]QPRD = PRD after quantization

[4]CR = Compression Ratio

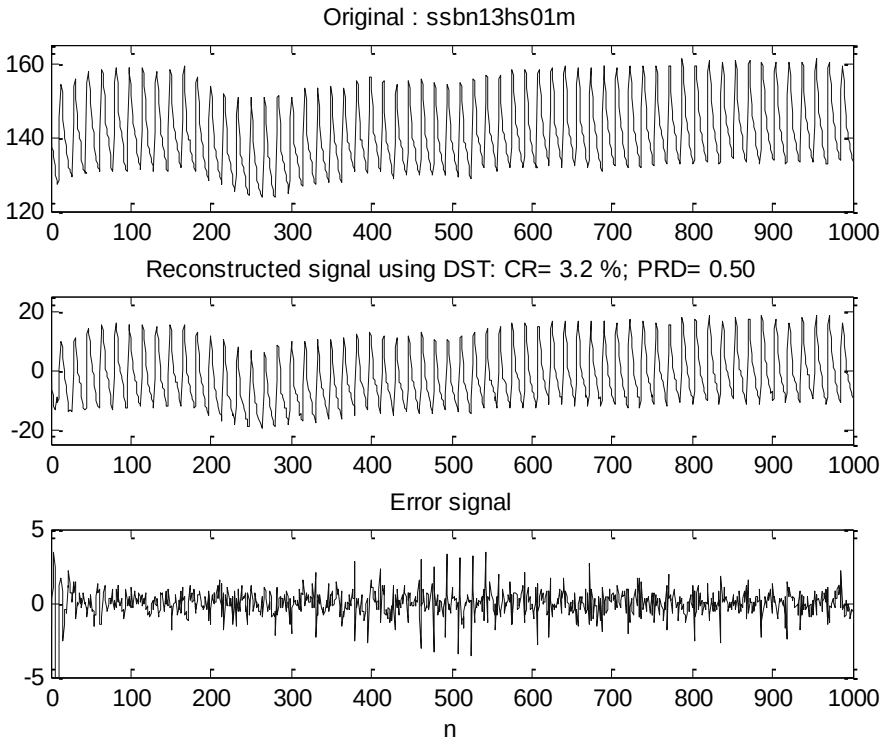

Fig. 1. Compression waveform of record ssbn13hs01m using Fractional Fourier Transform at UPRD=0.5.

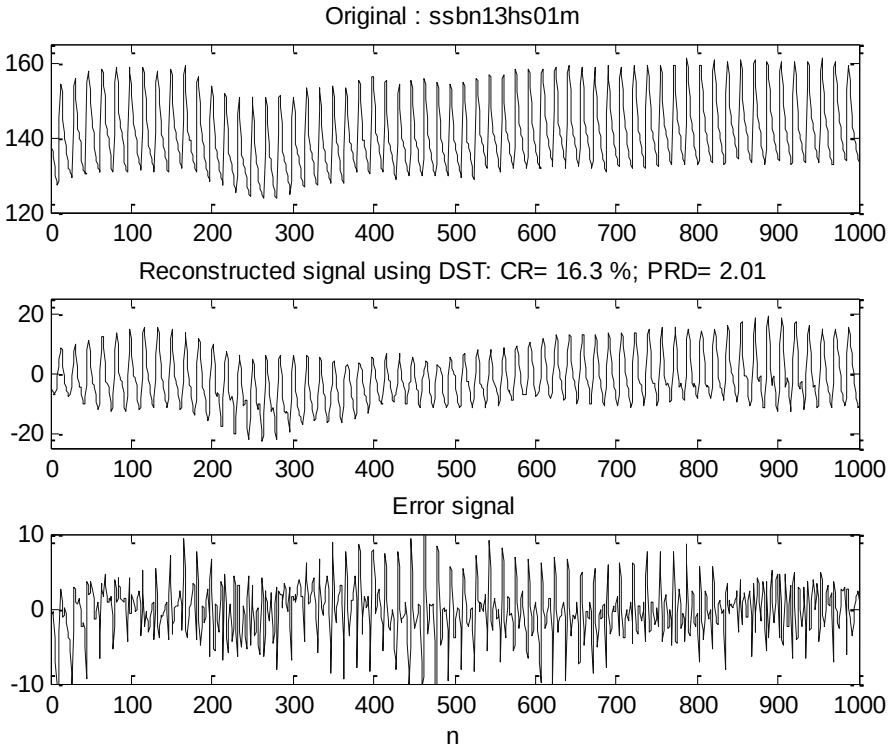

Fig. 2. Compression waveform of record ssbn13hs01m using Fractional Fourier Transform at UPRD=2.

CONCLUSION

The quality controlled DST based compression method for BP Signal in Salt Sensitive Dahl Rat is presented. The results shows that mean CR with DST is significantly higher than FRFT mean CR and it directly proportional to user defines PRD (UPRD). In future, study can be forwarded by examine these results using other transforms and for supplementary signal characteristics.

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