

Article

A Case Study and Analysis of Information Theory and Coding

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A B S T R A C T

The main objective of the paper to talk about advantage and knowledge domain of the analog feedback communication and estimate similarities or dissimilarities between the two things which come near to their and digital communication system optimization. There is shown extreme differences between mathematical devices used for detailed examination of the element and optimization of analog feedback communication and digital communication system which officially allow to do something to look attentively at the approaches to their optimization as free from outside control directions of research in information theory.¹

The main cause of disagreement is calculable disagreement of the source of signal transmitted by the system. Both the system analog feedback communication and digital communication system solve the same task by using completely dissimilar methods. The outcome of detailed examination of the element show the digital communication system are impossible for the digital signal transmission. In whatever way, who's optimal in analog feedback system can be relevant, they transmit analog signal with the greater power bandwidth quality than digital communication system designed for same application.

Keywords: Analog Transmission, Adaptive Modulation, Feedback, Optimality, Information Limits

Introduction

The main purpose of the electronic communication system is to transfer information from one person to another. Information theory reads the quantification, storage, communication of information. Information can be idea of as the resolution of uncertainly in which "information" is thought of as a set of likely letters, where main goal to send this messages over noisy channel and receiver built the messages with low probability of error, in spite of the channel noise.²

Information Theory is connected with group of things of pure and applied disciplines that have been carry out a systematic and make smaller to engineering practice under a variety of rubrics throughout the world over the time

before the moment century adaptive system, anticipatory system, artificial intelligence, complex system, complexity science, informatics, machine learning along with the system science of many description.

Coding theory concerned with the act obvious approaches named codes, for cumulative the state or less error rate of data communication completed noisy channel to nearby channel capacity. These codes can be unevenly sectioned into data compression and error correction practices.

History of Information Theory and Coding

The object event that set up on a firm the discipline of information theory and brought it to occurring international notice taken of someone attention was the publication of Claude E Shannon's "A mathematical theory of

communication" in bell system technical journal in July and October 1948.³

The limited information well developed at Bell labs, all that is not directly expressed assuming event of equal quality, Harry Nyquists 1924 paper, certain factors affecting telegraph speed, contains a concerned with section measure "intelligence" and "line speed" through which can transmitted by a communication system.⁴

According to Reaction

$W = k \log n$

W= speed of transmission of intelligence

K=constant

M=no of different voltage levels to choose from at each time step.

Ralph Hartley's 1928 paper, transmission of information, uses the word information as a able to be measured quantity, think deeply the receiver's skill to distinguish one sequence of symbols from any other, thus evaluate info as

$H = \log S^n = n \log S$

S=no of possible symbol

N=no of symbols in a transmission.

The individual things of facts provided was consequently the decimal digit, which has after all thing been called the Hartley in the honor measure of information.

The mathematics behind the information theory is different types of probabilities which developed from the field of thermodynamics by Ludwig Boltzmann & J. Willard Gibbs, connection between the information theoretic entropy & thermodynamics entropy, including the important contribution by Rolf Landauer in the 1960's are discuss in details in entropy in thermodynamics and information theory.⁵

The Shammon's revolutionary and ground breaking paper, they both completed the work at Bell Laboratory by the end of 1944, Shannon first time introduce the quantitative and qualitative model of communication.

According to define : "the fundamental problem of communication is that of reproducing at one point, either exactly or approximately a message selected at another point."

Working of Information Theory and Coding

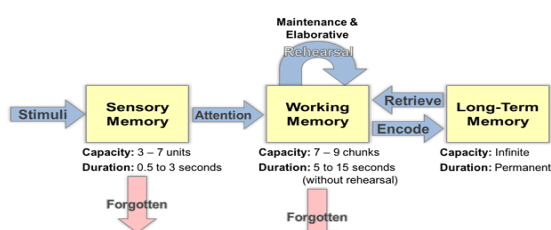


Figure 1. Working

Quantities of Information Theory and Coding

Entropy: It can be defined as a measure of average information content per source symbol Claude Shannon which is known as "father of information theory" gives formula

$$H = -\sum p_i \log_b p_i$$

p_i = probability of occurrence of character number

i = stream of character

b = base of algorithm

Hence, this formula is called as Shannon's Entropy.

Joint Entropy: the joint entropy of random variable X and Y is just the entropy of pairing (X, Y). It implies that X and Y are independent, then their joint entropy is the sum of individual entropies.⁶

Example

If X and Y are two separate random variable which signify the position of chess piece X-row and Y-column then the joint entropy of row and column of the piece will be the entropy of the position of the piece.

$$H(X, Y) = E_{x,y} [-\log p(x, y)] = -\sum_{(x,y)} p(x, y) \log p(x, y)$$

Mutual information

Let we considered a two channel whose output is Y and input is X

Entropy of prior uncertainly $X = H_x$

To know the output, after input is applied, let us consider conditional entropy given that $Y = y_k$

$$H(x | y_k) = -\sum p(x_j | y_k) \log [1 / p(x_j | y_k)]$$

Random variable of $H(x | y = y_0)$ $H(x | y = y_k)$ with the probability $p(y_0)$, $p(y = y_{k-1})$ respectively [7].

Coding Theory

It is one of the most important use of coding theory. It divided into two parts source and channel coding. The division of coding theory into compression and transmission can be justified by information transmission theorem, or source-channel separation theorem that justify the use of bits as the universal currency of information in many contents.

Source coding: The code word is always greater than or equal to the source code which means, the symbol in the code word are greater than or equal to the alphabets in the source code.

Channel coding: In a communication system, introduce dismissal with a control, so to improve the reliability of the system source code reduce the redundancy to improve the efficiency of the system.

- Mapping – Incoming data sequence into a channel input sequence.

- Inverse mapping – The channel output sequence into an output data sequence.

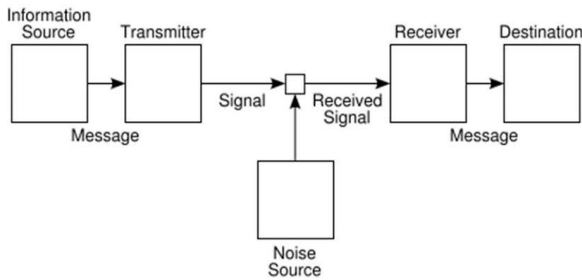


Figure 2. Channel coding

Applications

Efficiency and capacity of the computer and similar devices

We address the problem of what efficiency and capacity of a computer are and how they can be estimated.

The several examples which are some theoretical and practical interest.

Video Abstraction

It is the act of representing essential features which does not include the background details.

Secure data transmission

It refers to the transmission of data such as proprietary information over a secure channel. There are many secure channel which required the encryption.

Channel Capacity

The capacity of channel is the theoretical upper limit to the bit rate of a given channel which is result in negligible error. Its channel capacity is measured in bits.

Waveform Coding

It is type of speech used in the public switched of sending a waveform might be called "Brute force coding"[8].

Lossless

It is a method of data compression in which size of file is reduced without sacrificing original quality.

Cryptography

It is a method of protecting information and communication through use of codes so that only those for whom the information is intended can read and process.

Advantages and Disadvantages of Information Theory and Coding

Advantages

- Because of their digital nature they can travel faster in over digital lines ability to transfer more data as compared to analog.

- It quantifies single-trial stimulus ability on a meaningful scale.
- It is a principled measure of the correlation on a single trial basis between neuronal responses and stimuli.
- It works even in non-linear situations.
- It makes no assumption about the relation between stimulus and response-we do not need to specify which features of the stimulus activate the neuron and how they activate it.

Disadvantages

- Superior bandwidth is important.
- Schemes and dispensation is additional multifaceted.
- Unsolicited noise in demo.
- If we communicate data at long distance then unwanted trouble is there.
- Generation loss is also a big cons of analog signals.

Review

We scrutinize how information theory has been used to study cognition over the last seven decades. After an initial burst of activity in the 1950s, the backlash that followed stopped most work in this area. The last couple of decades has seen both a revival of interest, and a more firmly grounded, experimentally justified use of information theory. We can interpretation cognition as the progression of converting perceptions into information-where we use info in the colloquial sense of the word. This last explanation is one of the problems we run into when trying to use info theoretic principles to comprehend or examine cognition. Information theory is precise, while cognition is a particular occurrence. It is moderately simple to observe an abstract association among insight and data; it is an alternate issue out and out to apply the meticulousness of data hypothesis to the procedure of perception. In this paper, we will take a gander at the numerous manners by which individuals have attempted to lighten this issue. These methodologies extend from narrowing the concentration to just quantifiable parts of comprehension or getting calculated hardware from data hypothesis to address issues of discernment. We portray uses of data hypothesis over a scope of comprehension inquire about, from neural coding to subjective control and prescient coding.

Conclusion

Information theory obviously shows that the amount of data conveyed by a succession of amino acids is just adequate to produce beginning time collapsing middle of the road and that extra data must be given so as to effectively demonstrate the rest of the collapsing procedure. We propose that this data originates from the outside condition, which assumes a urgent job in deciding the ES structure stays essential as a beginning stage with the expectation of complimentary vitality minimization calculations. It merits

nothing that our proposition model gives such a structure, alongside an away from of how it is acquired and what systems are liable for this.

Information theory is firmly connected with an assortment of unadulterated and applied controls that have been researched and diminished to building practice under an assortment of rubrics all through the world over the past 50 years or increasingly: versatile frameworks, expectant frameworks, man-made consciousness, complex frameworks, unpredictability science, artificial intelligence, informatics, AI, alongside frameworks studies of numerous depictions. Data hypothesis is a wide and profound numerical hypothesis, with similarly expansive and profound applications, among which is the imperative field of Coding Theory.

Coding Theory is worried about finding express techniques, called codes, for expanding the productivity and lessening the blunder pace of information correspondence over boisterous channels to approach the channel limit. These codes can be generally partitioned into information pressure (source coding) and blunder revision (channel coding) strategies. In the last case, it took numerous years to discover the strategies Shannon's work demonstrated were conceivable.

A second rate class of data hypothesis codes are cryptographic calculations (the two codes and figures). Ideas, techniques and comes about because of coding hypothesis and data hypothesis are generally utilized in cryptography and cryptanalysis.

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