

Chapter 11

Bernoulli's Chaotic Map–Based 2D ECG Image Steganography: A Medical Data Security Approach

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ABSTRACT

Signal processing technology comprehends fundamental theory and implementations for processing data. The processed data is stored in different formats. The mechanism of electrocardiogram (ECG) steganography hides the secret information in the spatial or transformed domain. Patient information is embedded into the ECG signal without sacrificing the significant ECG signal quality. The chapter contributes to ECG steganography by investigating the Bernoulli's chaotic map for 2D ECG image steganography. The methodology adopted is 1) convert ECG signal into the 2D cover image, 2) the cover image is loaded to steganography encoder, and 3) secret key is shared with the steganography decoder. The proposed ECG steganography technique stores 1.5KB data inside ECG signal of 60 seconds at 360 samples/s, with percentage root mean square difference of less than 1%. This advanced 2D ECG steganography finds applications in real-world use which includes telemedicine or telecardiology.

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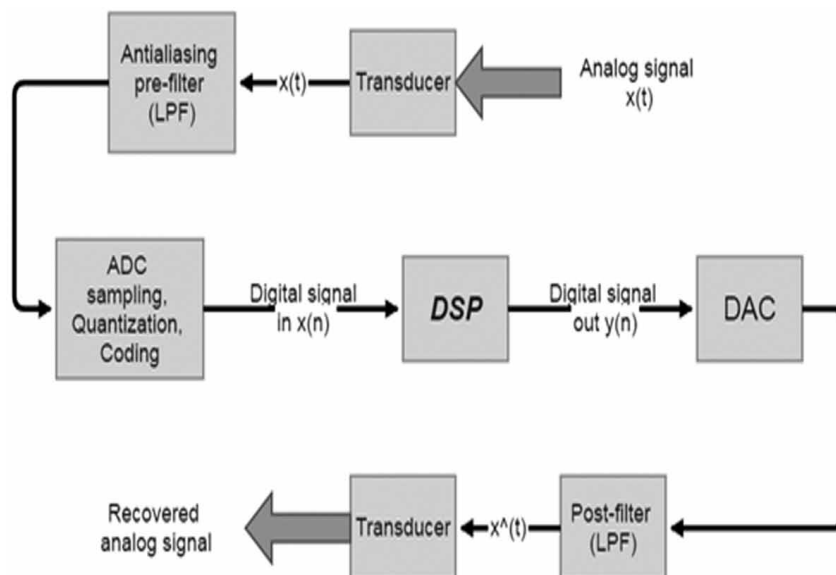
INTRODUCTION

Signal processing is used everywhere either to convert information-carrying signals from one form to another or for extracting the information from signals (Biswas, 2013). The transmission of a biomedical signal is shown in Figure 1.

Digital signal processing is a category of signal processing that is the numerical manipulation of the signals with the intention to filter, measure, produce, and compress the continuous analog signals. It uses the digital signals for representing them as discrete domain signals as sequence of symbols or numbers that enable the digital processing of the signals. Such a processing involves both linear and non-linear operations. Thus, Bio-medical signal processing is a branch of science for the manipulation of the bio signals or biomedical signals such as Electroencephalography, Electrocardiography, Electromyography (Chang & Lu, 2006).

The manipulation of bio signals includes filtering, encryption, compression, steganography etc. Steganography is the science that falls under the category of secure communications. Its main purpose is to visually hide the secret data in a carrier during communication (A. Pandey, Saini, Singh, & Sood, 2017). It can be interlinked with two other types of security systems, namely cryptography and watermarking. Steganography concerns about the hiding of digital data while watermarking deals with copyright protection of digital data. Although for last couple of millennium, the science of cover writing has been used in diversified forms (Cheddad, Condell, Curran, & Mc Kevitt, 2010), but can be comprehensively divided into two categories. Linguistic steganography is the first one, which was widely used in ancient time, uses the natural language as a carrier in hiding the message in original form. In the early fifth century BC, Histaiacus tried to conceal the secret information made on slave's shaved head in the form of a tattoo and dispatched after his hair grew back with the message. Technical steganography is the second class, which employs the digital data as carrier, such as text, images, video and audio.

Figure 1. Schematic for transmission and reception process of a signal



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