Chapter 3
Design of Logistic Map-Based Spreading Sequence Generation for Use in Wireless Communication

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ABSTRACT

Spread spectrum modulation (SSM) finds important place in wireless communication primarily due to its application in Code Division Multiple Access (CDMA) and its effectiveness in channels fill with noise like signals. One of the critical issues in such modulation is the generation of spreading sequence. This chapter presents a design of chaotic spreading sequence for application in a Direct Sequence Spread Spectrum (DS SS) system configured for a faded wireless channel. Enhancing the security of data transmission is a prime issue which can better be addressed with a chaotic sequence. Generation and application of chaotic sequence is done and a comparison with Gold sequence is presented which clearly indicates achieving better performance with simplicity of design. Again a multiplierless logistic map sequence is generated for lower power requirements than the existing one. The primary blocks of the system are implemented using Verilog and the performances noted. Experimental results show that the proposed system is an efficient sequence generator suitable for wideband systems demonstrating lower BER levels, computational time and power requirements compared to traditional LFSR based approaches.

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INTRODUCTION

Over the last decades there has been an exponential growth in wireless communication systems. Among many techniques develop for communication through the wireless medium, spread spectrum modulation (SSM) finds an important place in wireless communication due to many striking features like robustness to noise and interference, low probability of intercept, application to Code Division Multiple Access (CDMA) and so on. The idea behind SSM is to use more bandwidth than the original message while maintaining the same signal power. A spread spectrum signal does not have a clearly distinguishable peak in the spectrum. This makes the signal more difficult to distinguish from noise and therefore more difficult to jam or intercept. There are two predominant techniques to spread the spectrum, one is the frequency hopping (FH) technique, which makes the narrow band signal jump in random narrow bands within a larger bandwidth. Another one is the direct sequence (DS) technique which introduces rapid phase transition to the data to make it larger in bandwidth (Rappaport, 1997). Pseudo noise (PN) sequence, Gold code etc are the spreading codes which play a prominent role in SSM techniques. There are used as spreading code in SSM. A PN code is one that has a spectrum similar to a random sequence of bits but is determinately generated (Tse & Viswanath, 2005). A Gold code is a type of binary sequence, used in telecommunication primarily in CDMA and satellite navigation system like GPS (Tse & Viswanath, 2005). Gold codes have bounded small cross-correlations within a set, which is useful when multiple devices are broadcasting in the same frequency range. A set of Gold code sequences consists of 2^n-1 sequences each one with a period of 2^n-1. But PN and Gold codes are limited to fixed sequence lengths with a system configuration. Again flexibility is also poor because for same sequence length we cannot generate multiple numbers of sequences. Traditionally, to generate PN sequence, linear feedback shift register (LFSR) and certain sum-store blocks are used. Since Gold code is generated by doing exclusive-OR of two PN sequences, here also LFSR is required. Therefore, to generate PN or Gold code, a definite physical structure is required which consume significant power. The fixed length of LFSRs improve further constraints. The PN sequence length become confined within the LFSR size. In fading situations or in conditions where there are variations in the propagation medium, a varying length PN sequence shall be more suitable than a fixed length one primarily to use the advantages of SSM to counter detrimental effects observed in wireless channels. Continuous researches are going on to design devices that save power and demonstrate dynamic

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