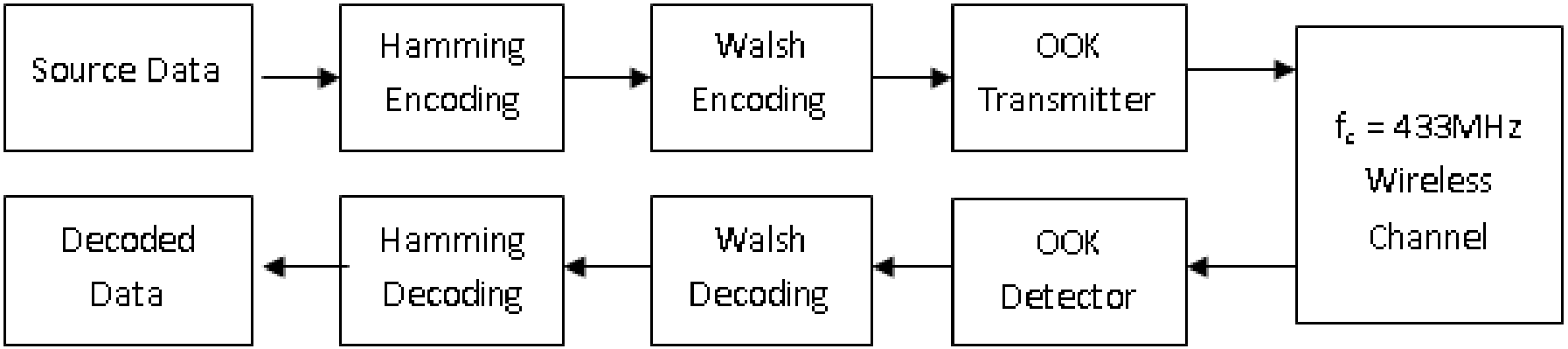
Wireless Transceiver Using Walsh Code and Hamming Code

Di Mu

Introduction

- This design is a wireless transmission system based on FPGA and wireless link.
- To reduce bit errors, Hamming code is used to detect and correct bit errors.
- And Walsh code is used to generate orthogonal transmission signals and provide spread spectrum.

Block Diagram

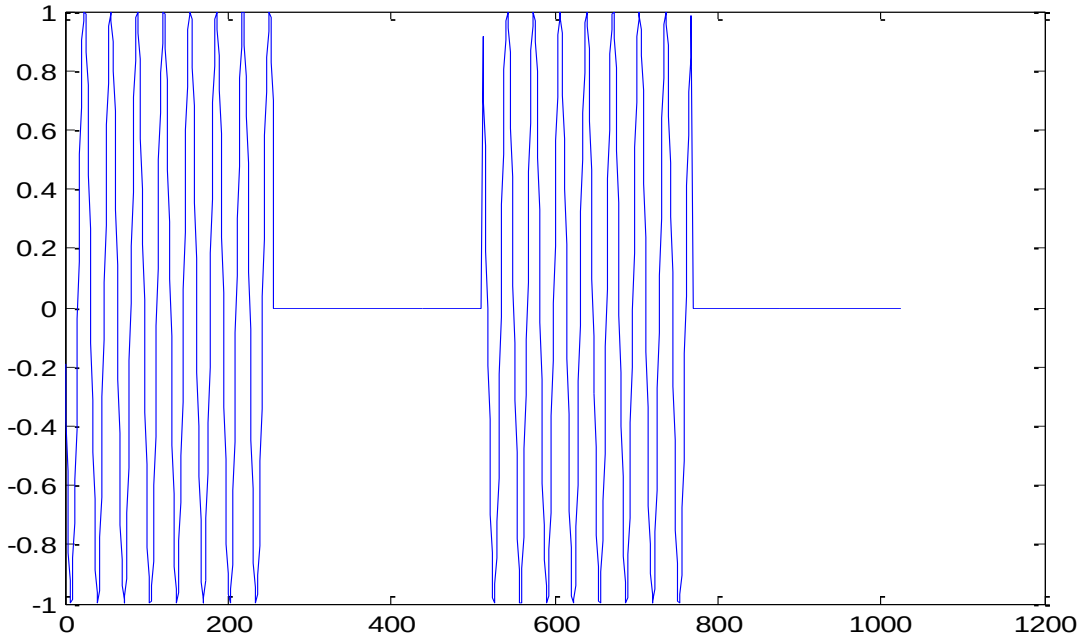


Wireless link

- The wireless link is a pair of transmitter and receiver modules, which are using the simplest digital modulation method -- On-Off Keying.
- And the channel in use is 433MHz, which is a license-free frequency.
- Error bit 0->1 is more likely than 1->0.

Wireless link

- The hardware detector will use the envelop of the signal to decide 0 and 1 bits. The threshold is half voltage.
- OOK waveform:



Hamming Code

- In this project, Hamming (7,4) code is used to correct the bit errors.
- 4 bits are inserted to each 7 message bits to make sure there are even ones in the sets of bits.

Bit position		1	2	3	4	5	6	7	8	9	10	11
Encoded data bits		p1	p2	d1	p4	d2	d3	d4	p8	d5	d6	d7
Parity bit coverage	p1	X		X		X		X		X		X
	p2		X	X			X	X			X	X
	p4				X	X	X	X				
	p8								X	X	X	X

Walsh-Hadamard Code

- In this project, I'm using 4-by-4 walsh code. Each row are orthogonal to each other.
- This is a method of spread spectrum. Four symbols (or users) can transmit at same time.

$$\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & -1 & -1 \\ 1 & -1 & -1 & 1 \\ 1 & -1 & 1 & -1 \end{bmatrix}$$

Synchronization

- To let the receiver know when is the start of a bit stream, a synchronization method is necessary.

  The frame structure is as diagram below:

