

# Advanced automotive application based on VHDL & MATLAB for correlation radar (anti-collision system)

Vikash Kumar Dwivedi<sup>1</sup>, Sarla Singh<sup>2</sup>, Anil Mishra<sup>3</sup>

M-tech scholar<sup>1</sup>, Asst. Prof. JNCT Rewa<sup>2</sup>, HOD JNCT Rewa<sup>3</sup>  
vkbbhabha1@gmail.com<sup>1</sup>, sarlasingh\_mits@rediffmail.com<sup>2</sup>, anilmishraec@gmail.com<sup>3</sup>

**ABSTRACT:-** RADARs which is used for road anti-collision system, although recent developments in chip manufacturing technology provides as capability to make it multi-function device such that it can be used for automatic driving system but this is another goal, presently we discuss aspect when a large number of vehicles will use this technology then the interference produced by their signals can totally jam the radar hence it become totally unusable to avoid this problem we analyzed the performance of correlation radar for different PN sequences under interference & noisy condition so that the best PN sequence which can properly work on such conditions can be found. We detect the position and get the identification and status of the obstacles. We compute, in real time, the distances toward the preceding vehicles and allow a high data rate communication for exchange data information between obstacles and measure its relative speed.

**KEYWORDS:-** PN Sequence, PRBS, Anti-collision, Doppler effect.

## INTRODUCTION

The basic principle of operation of primary radar is simple to understand. The implementation and operation of primary radars systems involve a wide range of disciplines such as building works, heavy mechanical and electrical engineering, high power microwave engineering, and advanced high speed signal and data processing techniques. A radar system has a transmitter that emits radio waves called radar signals in predetermined directions. When these come into contact with an object they are usually reflected and/or scattered in many directions. The radar signals that are reflected back towards the transmitter are the desirable ones that make radar work. If the object is moving either closer or farther away, there is a slight change in the frequency of the radio waves, due to the Doppler Effect.

Radar receivers are usually, but not always, in the same location as the transmitter. Although the reflected radar signals captured by the receiving antenna are usually very weak, these signals can be strengthened by the electronic amplifiers that all radar sets contain. Radar measurement of range, or distance, is made possible because of the properties of radiated electromagnetic energy.

The electromagnetic waves are reflected if they meet an electrically leading surface. If these reflected waves are received again at the place of their origin than that means an obstacle is in the propagation direction. Electromagnetic energy travels through air at a constant speed, at approximately the speed of light,

1. 300,000 kilometers per second or
2. 186,000 statute miles per second or
3. 162,000 nautical miles per second.

This constant speed allows the determination of the distance between the reflecting objects (airplanes, ships or cars) and the radar site by measuring the running time of the transmitted pulse. This energy normally travels through space in a straight line, and will vary only slightly because of atmospheric and weather conditions. By using of special radar antennas this energy can be focused into a desired direction. Thus the direction (in azimuth and elevation) of the reflecting objects can be measured. These principles can basically be implemented in a radar system, and allow the determination of the distance, the direction and the height of the reflecting object.

One has to resolve two problems with this principle:

- prevent a direct connection of the transmitted energy into the receiver (feedback connection),
- Assign the received echoes to a time system to be able to do run time measurement.

A direct connection of the transmitted energy into the receiver can be prevented by:

- spatial separation of the transmitting antenna and the receiving antenna, e.g. the aim is illuminated by a strong transmitter and the receiver is located in the missile flying direction towards the aim;
- Frequency dependent separation by the Doppler-frequency during the measurement of speeds.

A run time measurement isn't necessary for speed gauges, the actual range of the delinquent car doesn't have a consequence. If you need range information, then the time measurement can be realized by a frequency modulation or phase keying of the transmitted power. A CW-radar transmitting an un-modulated power can measure the speed only by using the Doppler-effect. It cannot measure a range and it cannot differ between two reflecting objects.

### Correlation Radar

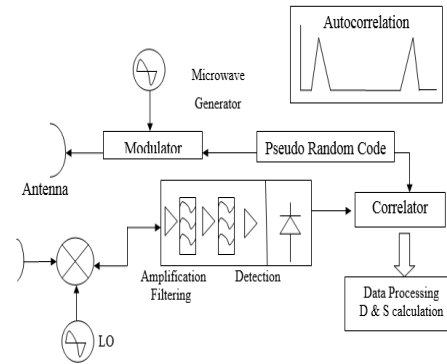
The most important radar used in this project is correlation RADAR whose function is to provide the matching between transmitted and received signal and the matched signal is send to comparator for comparing the data Digital intercorrelation function is given above .The classical correlation is the sum of sample product X and Y, with Y being only shifted in time. Zeros replace gaps in the shifted sequence.

We don't used classical correlation function but a cyclic one is used. Instead of a simple time shift the cyclic correlation perform a circular permutation of the second sequence.

Pseudo random sequence can be unipolar or bipolar. For unipolar sequence, chips can take the value 0 and 1 when a bipolar sequence can have values -1 or 1. We used unipolar sequences and this sequence is generated by using shift register. Pseudo random binary sequences are generated using some specific outputs of the register's flip flops are fed-back via a XOR gate. This feedback is done so that the register plays its (2n-1) possible states, such as n is the number of flip-flops forming the shift register. Thus, we get what is called a maximum length sequence.

$$C_{xy}(k) = \sum_{i=0}^N x(i) y(k+i)$$

Where  $C_{xy}$  is the correlation,  $N$  is the number of samples and  $k$  is the time shift.



### PRBS

PRBS or Pseudo Random Binary Sequence is essentially a random sequence of binary numbers. It is random in a sense that the value of an element of the sequence is independent of the values of any of the other elements. It is 'pseudo' because it is deterministic and after N elements it starts to repeat itself, unlike real random sequences..Examples of random sequences are radioactive decay and white noise. A binary sequence (BS) is a sequence of N bits, a  $j$  for  $j = 0, 1, \dots, N - 1$ , i.e.  $m$  ones and  $N-m$  zeros. A binary sequence is pseudo-random(PRBS) if its autocorrelation function, has only two values.

PRBS is implemented using LFSR or Linear Feedback Shift Register. LFSR is an  $n$ -bit shift register which pseudo-randomly scrolls between  $2^n-1$  values, but does it very quickly because there is minimal combinational logic involved. Once it reaches its final state, it will traverse the sequence exactly as before.

The general principle of correlation radar is to continually transmit a Pseudo Random Binary Sequence (PRBS) towards a potential target. The signal received back after reflection from the target determines its distance and relative speed.

### Shift Register

One of the two main parts of an LFSR is the shift register (the other being the Feedback function). A shift register is a device whose identifying function is to shift its contents into adjacent positions within the register or, in the case of the position on the end, out of the register. The position on the other end is left empty unless some new content is shifted into the register. The contents of a shift register are usually thought of as being binary, that

is, ones and zeroes. If a shift register contains the bit pattern 1101, a shift (to the right in this case) would result in the contents being 0110; another shift yields 0011. After two more shifts, things tend to get boring since the shift register will never contain anything other than zeroes.

Two uses for a shift register are:

- 1) Convert between parallel and serial data
- 2) Delay a serial bit stream.

The conversion function can go either way -- fill the shift register positions all at once (parallel) and then shift them out (serial) or shift the contents into the register bit by bit (serial) and then read the contents after the register is full (parallel). The delay function simply shifts the bits from one end of the shift register to the other, providing a delay equal to the length of the shift register.

**Block in sequence generator**

It is used in a communication system. Blocks in the Sequence Generators sub library generate

1. Pseudorandom sequence
2. Synchronization codes
3. Orthogonal codes

**Pseudorandom Sequences**

The following table lists the blocks that generate pseudorandom or pseudo noise (PN) sequences. The applications of these sequences range for target detection and communication systems to ranging, synchronization, and data scrambling.

SEQUENCE	BLOCK
Gold Sequence	Gold Sequence Generator
Kasami Sequence	Kasami Sequence Generator
PN sequence	PN sequence Generator

Table 1. Different Types of Sequences

All three blocks use shift registers to generate pseudorandom sequences. The following is a schematic diagram of a typical shift register.

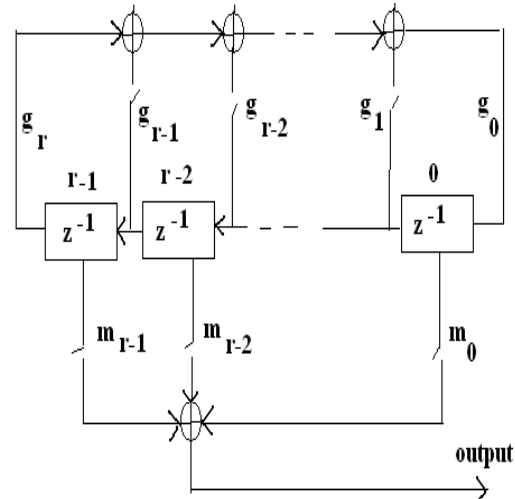


Fig. Schematic diagram of a typical shift register.

All  $r$  registers in the generator update their values at each time step according to the value of the incoming arrow to the shift register. The adders perform addition modulo 2. The shift register can be described by a binary polynomial in  $z$ ,  $g_r z^r + g_{r-1} z^{r-1} + \dots + g_0$ . The coefficient  $g_i$  is 1 if there is a connection from the  $i$ th shift register to the adder, and 0 otherwise.

The Kasami Sequence Generator block and the PN Sequence Generator block use this polynomial description for their Generator polynomial parameter, while the Gold Sequence Generator block uses it for the preferred polynomial [1] and preferred polynomial [2] parameters. The lower half of the preceding diagram shows how the output sequence can be shifted by a positive integer  $d$ , by delaying the output for  $d$  units of time. This is accomplished by a single connection along the  $d$ th arrow in the lower half of the diagram. It is of three types.

**Gold Sequence**

A Gold code, also known as Gold sequence, is a type of binary sequence, used in telecommunication and satellite navigation (GPS). Gold codes are named after Robert Gold. Gold codes have bounded small cross-correlations within a set, which is useful when multiple devices are broadcasting in the same range. A set of Gold code sequences consists of  $2^n - 1$  sequences each one with a period of  $2^n - 1$ .

A set of Gold codes can be generated with the following steps. Pick two maximum length sequence of the same length  $2^n - 1$  such that their absolute cross-correlation is less than or equal to  $2^{(n+2)/2}$ , where  $n$  is the size of the LFSR used to generate the maximum length sequence (Gold '67).

The set of the  $2^n - 1$  exclusive-ors of the two sequences in their various phases (i.e. translated into all relative positions) is a set of Gold codes. The highest absolute cross-correlation in this set of codes is  $2^{(n+2)/2} + 1$  for even  $n$  and  $2^{(n+1)/2} + 1$  for odd  $n$ . The exclusive or of two Gold codes from the same set is another Gold code in some phase. Within a set of Gold codes about half of the codes are balanced — the number of ones and zeros differs by only one.

### **Kasami Sequence**

Kasami sequences are binary sequences of length  $2^N$  where  $N$  is an even integer. Kasami sequences have good cross-correlation values approaching the Welch lower bound. There are two classes of Kasami sequences - the small set and the large set.

The small set

The process of generating a Kasami sequence starts by generating a maximum length sequence  $a(n)$ , where  $n=1..2^N-1$ . Maximum length sequences are periodic sequences so  $a(n)$  is repeated periodically for  $n$  larger than  $2^N-1$ . Next we generate another sequence  $b(n) = a(q*n)$  where  $q = 2^{N/2}+1$ . Kasami sequences are formed by adding  $a(n)$  and a time shifted version of  $b(n)$  modulo two. The set which is formed by taking all Kasami sequences generated by different time shifts of  $b(n)$  plus the  $a(n)$  and  $b(n)$  sequence forms the Kasami set of sequences. This set has  $2^{N/2}$  different sequences.

### **PN Sequence**

PN sequences or Pseudo Noise sequence is a periodic binary code which is random in nature generated by the use of shift registers, but generated with taking into considerations some generator polynomials. For sequence to be a pseudo noise or pseudo random it should follow the following basic rules. The rules mentioned below are simply mentioned in brief:

1. The relative frequency of 0's and 1's are each  $\frac{1}{2}$ .
2. The run lengths of 0's and 1's are:  $\frac{1}{2}$  of all run lengths are of length 1;  $\frac{1}{4}$  are of length 2;  $\frac{1}{8}$  are of length 3; and so on.

If a PN sequence is shifted by any non-zero number of elements, the resulting sequence will have an equal number of agreements and disagreements with respect to the original sequence. These properties are known also known as balance property, run property, and correlation property respectively. This code is orthogonal in nature. PN sequence is also known as Maximal Length

Sequences. PN sequences are used in spread spectrum systems, like CDMA, WCDMA, and Radar etc. In CDMA IS 95, 64 long PN sequence codes are used for the identification if the reverse link channels.

### **Synchronization codes**

The Barker Code Generator block generates Barker codes to perform synchronization. Barker codes are subsets of PN sequences. They are short codes, with a length at most 13, which are low-correlation side lobes. A correlation side lobe is the correlation of a codeword with a time-shifted version of itself.

### **Orthogonal codes**

Orthogonal codes are used for spreading to benefit from their perfect correlation properties. When used in systems, where the receiver is perfectly synchronized with the transmitter, the despreading operation is ideal. Orthogonal codes have zero cross-correlation. They may seem to be attractive to replace PN codes which have non-zero cross-correlations but things are not going perfect. The cross-correlation value is zero only when there is no offset between the codes. In fact, they have large cross-correlation values with different offsets, much larger than PN codes. The autocorrelation property is usually not good either. Orthogonal codes have an application in perfectly synchronized environments such as in the forward link of mobile communications. There are several code expansion techniques to generate orthogonal codes. Probably Hadamard transform is the best known technique. A modified Hadamard transform also appears in a literature. Orthogonal Gold code shows reasonable cross-correlation and off-peak autocorrelation values while providing perfect orthogonality in zero-offset case. Multi-rate orthogonal codes are attractive as they can provide variable spreading factors depending on the information rate. A dependency issue in multi-rate orthogonal code assignment is also interesting problem. All these topics are covered here with software implementation.

### **Hadamard codes generator**

The Hadamard code is a system used for signal error detection and correction. It is one of the family of  $[2^n, n+1, 2^{n-1}]$  codes. Especially for large  $n$  it has a poor rate but it is capable of correcting many errors. Hadamard codes can be considered as a special case of Reed–Muller codes. In particular, first orders Reed–Muller code are equivalent to Hadamard codes. The Hadamard Code Generator block generates a Hadamard code

from a Hadamard matrix, whose rows form an orthogonal set of codes. Orthogonal codes can be used for spreading in communication systems in which the receiver is perfectly synchronized with the transmitter. In these systems, the despreading operation is ideal, as the codes are decor related completely.

The Hadamard codes are the individual rows of a Hadamard matrix. Hadamard matrices are square matrices whose entries are +1 or -1, and whose rows and columns are mutually orthogonal. If  $N$  is a nonnegative power of 2, the  $N$ -by- $N$  Hadamard matrix, denoted  $H_N$ , is defined recursively as follows:

$$H_1 = [1]$$

$$H_{2N} = \begin{bmatrix} H_N & H_N \\ H_N & -H_N \end{bmatrix}$$

The  $N$ -by- $N$  Hadamard matrix has the property that

$$H_N H_N^T = N I_N$$

Where  $I_N$  is the  $N$ -by- $N$  identity matrix. The Hadamard Code Generator block outputs a row of  $H_N$ . The output is bipolar. You specify the length of the code,  $N$ , by the Code length parameter. The Code length must be a power of 2. You specify the index of the row of the Hadamard matrix, which is an integer in the range  $[0, 1 \dots N-1]$ , by the Code index parameter.

Codes	Block
Hadamard codes	Hadamard code generator
OVSF codes	OVSF code Generator
Walsh codes	Walsh code Generator

### OVSF Code Generator

Generate orthogonal variable spreading factor (OVSF) code from set of orthogonal codes. The OVSF Code Generator block generates an OVSF code from a set of orthogonal codes. OVSF codes were first introduced for 3G communication systems. OVSF codes are primarily used to preserve orthogonality between different channels in a communication system.

OVSF codes are defined as the rows of an  $N$ -by- $N$  matrix,  $C_N$ , which is defined recursively as follows. First, define  $C_1 = [1]$ . Next, assume that  $C_N$  is defined and let  $C_N(k)$  denote the  $k$ th row of  $C_N$ . Define  $C_{2N}$  by

$$C_{2N} = \begin{bmatrix} C_N(0) & C_N(0) \\ C_N(0) & -C_N(0) \\ C_N(1) & C_N(1) \\ C_N(1) & C_N(1) \\ \dots & \dots \\ C_N(N-1) & -C_N(N-1) \end{bmatrix}$$

Note that  $C_N$  is only defined for  $N$  a power of 2. It follows by induction that the rows of  $C_N$  are orthogonal.

### Walsh code generator

In coding theory, the Walsh-Hadamard code is an example of a linear code over a binary alphabet that maps messages of length  $n$  to codeword of length  $2^n$ . The Walsh-Hadamard code is unique in that each non-zero codeword has Hamming weight of exactly  $2^{n-1}$ , which implies that the distance of the code is also  $2^{n-1}$ . Furthermore, the Walsh-Hadamard code is a locally decodable code, which provides a way to recover parts of the original message with high probability, while only looking at a small fraction of the received word. This gives rise to applications in computational complexity theory and particularly in the design of probabilistically checkable proofs. It can also be shown that, using list decoding, the original message can be recovered as long as less than 1/2 of the bits in the received word have been corrupted.

The Walsh-Hadamard code is also used to uniquely define individual communication channels. Walsh-Hadamard codes are mathematically orthogonal codes. As such, if two Walsh-Hadamard codes are correlated, the result is intelligible only if these two codes are the same. As a result, a Walsh-encoded signal appears as random noise to a CDMA capable mobile terminal, unless that terminal uses the same code as the one used to encode the incoming signal. Walsh codes are defined as a set of  $N$  codes, denoted  $W_j$ , for  $j = 0, 1 \dots N - 1$ , which has the following properties:

$W_j$  takes on the values +1 and -1.

$W_j[0] = 1$  for all  $j$ .

$W_j$  has exactly  $j$  zero crossings, for  $j = 0, 1 \dots N - 1$ .

$$W_j W_k^T = \begin{cases} 0 & j \neq k \\ N & j = k \end{cases}$$

Each code  $W_j$  is either even or odd with respect to its midpoint.

Walsh codes are defined using a Hadamard matrix of order  $N$ . The Walsh Code Generator block outputs a row of the Hadamard matrix specified by the Walsh code index, which must be an integer in the range  $[0 \dots N - 1]$ . If you set Walsh code index equal to an integer  $j$ , the output code has exactly  $j$  zero crossings, for  $j = 0, 1, \dots, N - 1$ .

### Maximum unambiguous range

Once a signal is radiated into space by radar, sufficient time must elapse to allow all echo signals to return to the radar before the next pulse is transmitted. The rate at which pulses may be transmitted, therefore, is determined by the longest range at which target are expected. If the time between the pulses is too short, an echo signal from a long range target might arrive after the transmission of the next pulse and be mistakenly associated with that pulse rather than the actual pulse transmitted earlier. This can result in an incorrect or ambiguous measurement of the range. Echoes that arrive after the transmission of the next pulse are called second time around echoes. Such an echo would appear to be at a closer range than actual and its range beyond which target appear as second time around echoes is the maximum unambiguous range, denoted by  $R_{un}$

$$R_{un} = cT_p / 2 = c / 2f_p$$

Where  $T_p$  = pulse repetition period =  $1/f_p$  and  $f_p$  = pulse repetition frequency.

### Pseudorandom binary sequence

A binary sequence (BS) is a sequence of  $N$  bits,  $a_j$  for  $j = 0, 1, \dots, N - 1$ , i.e.  $m$  ones and  $N - m$  zeros. A BS is pseudo-random (PRBS) if its autocorrelation function:

Have only two values

$$C(v) = \sum_{j=0}^{N-1} a_j a_{j+v}$$

$$C(v) = \begin{cases} m, & \text{if } v=0(\text{mod } N) \\ mc, & \text{otherwise} \end{cases}$$

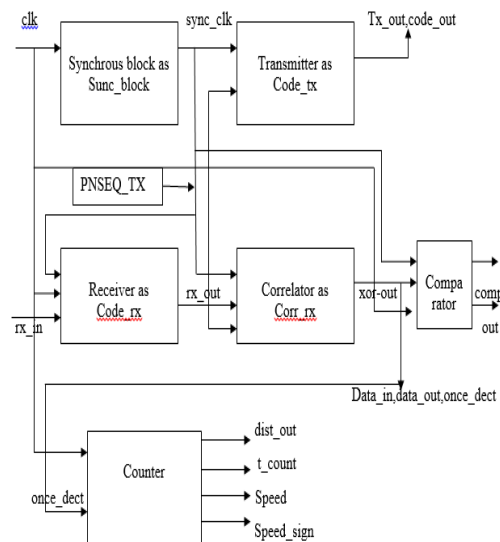
$$c = \frac{m-1}{N-1}$$

Where

Is called the duty cycle of the PRBS. A PRBS is random in a sense that the value of an  $a_j$  element is independent of the values of any of the other elements, similar to real random sequences. It is 'pseudo' because it is deterministic and after  $N$  elements it starts to repeat itself, unlike real random sequences, such as sequences generated by radioactive decay or by white noise. The PRBS is more general than the n-sequence, which is a special pseudo-random binary sequence of  $n$  bits generated as the output of a linear shift register. An n-sequence always has a  $1/2$  duty cycle and its number of elements  $N = 2^k - 1$ . PRBS's are used in telecommunication, encryption, simulation, and correlation technique and time-of-flight spectroscopy. The pseudo random sequences codes are also known as Maximum Length Sequence codes Known as m sequence. The Pseudo random number appears to be random, but not really random.

### Proposed work

The correlation radar is design and simulated with VHDL and MATLAB to verify and validate the radar specification. The correlation radar consist of Transmitter and receiver. The transmitter consist of delay block for providing delay up to 1000 clk and code generator based on PN sequence and receiver section consist of correlate which provide correlation between 128bit of transmitted and receiver data whose result is given to comparator which determine the output target and counter stop counting and the distance between the two obstacle is determine. The architecture block diagram of correlate radar is shown in figure



Results

XILINX Simulation results

Simulation result generated by XILINX 8.1i for correlation RADAR is shown in figure 6.1. Here inputs are clk (clock) to control the input signal data rate, and output is tx\_out (transmitter output), detected, distance, speed, speed sign (positive or negative distance). All the other figure shows the result of correlation RADAR and its internal block diagram. As shown in figure 6.1 seven modules are generated in I\_1, I\_2, I\_3, I\_4, I\_5, I\_6, I\_7. I\_1 is synchronous modules, I\_2 is code transmitter modules, I\_3 code receiver modules, I\_4 is correlation modules, I\_5 is comparator modules, I\_6 counter modules, I\_7 is speed modules. Output of the entire modules is desired correlation radar.

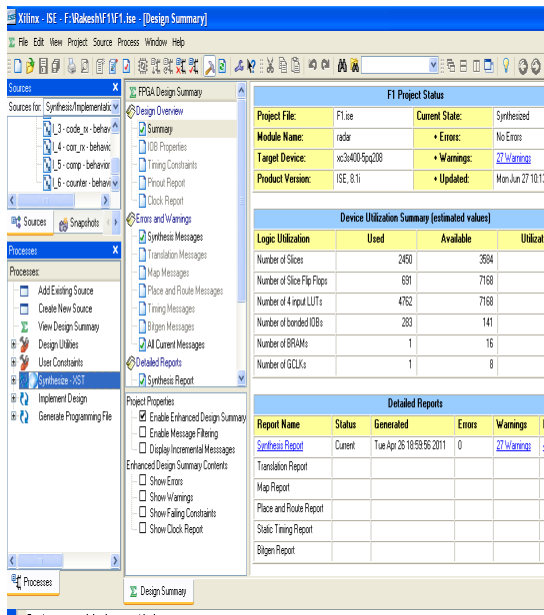


Fig. Design Summary for correlation RADAR

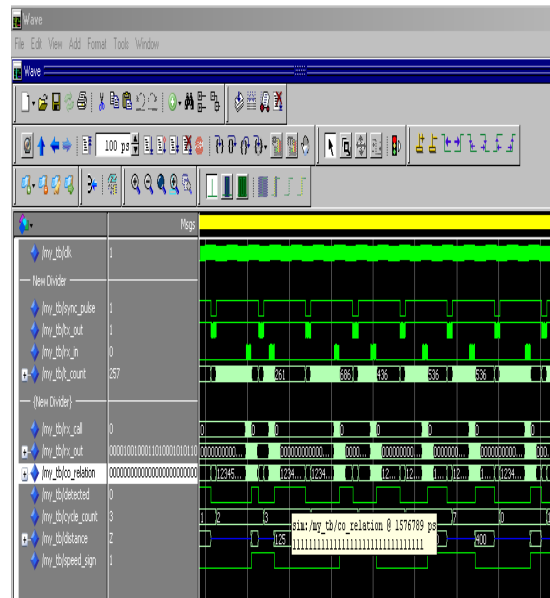


Fig. Shows the correlation between transmitted and received signal when clock =1, sync pulse =1, with count 257 and obstacle is detected which is output of correlation radar

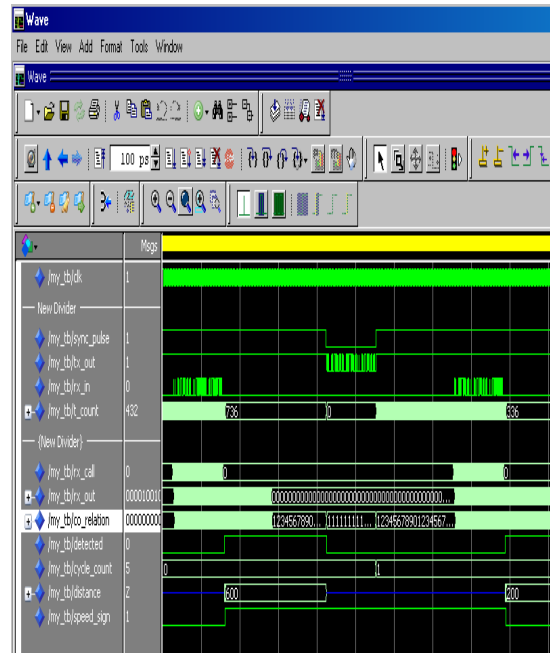


Fig. Shows the output at 432 count, when clock =1, sync pulse =1 and correlation between transmitted and received pulse





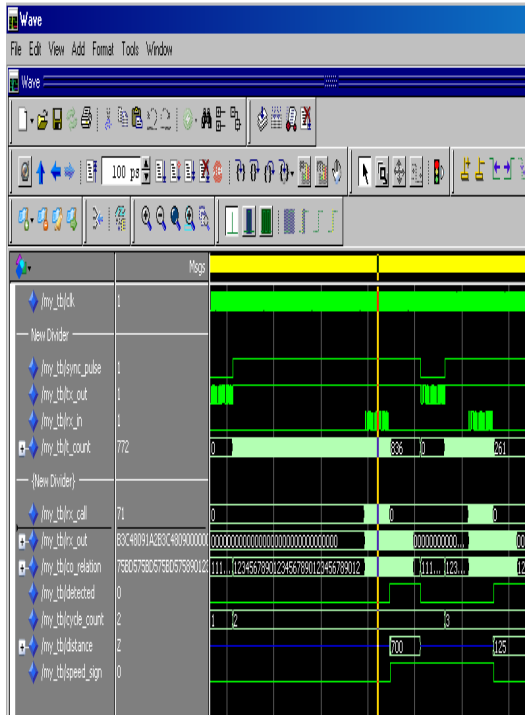


Fig. shows the output at clock =1, sync pulse =1, correlation is obtained between transmitted and received pulse at count 772, tx\_out =1, rx\_in =1, and obstacles is detected

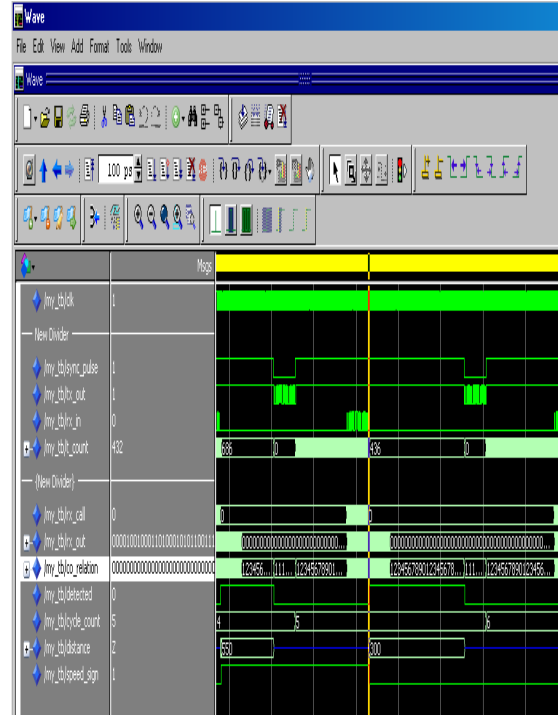


Fig. shows the output of receiver at clock =1, sync pulse =1, correlation is obtained between transmitted and received pulse at count 432, tx\_out =1, rx\_in =0, and obstacles is detected

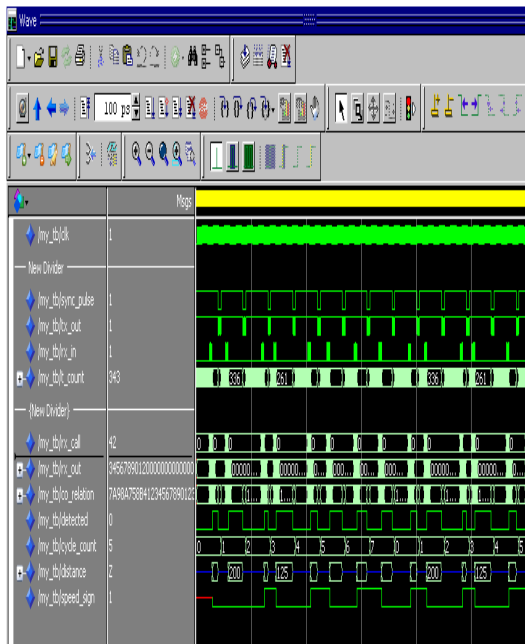


Fig. shows the output at clock =1, sync pulse =1, correlation is obtained between transmitted and received pulse at count 343, tx\_out =1, rx\_in =1, and obstacles is detected

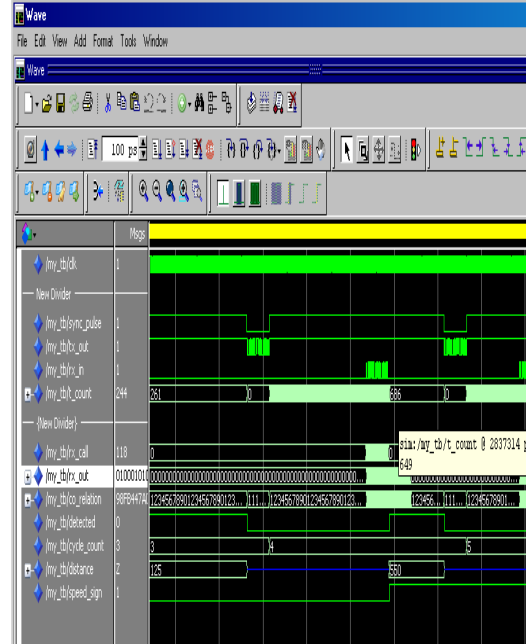


Fig. shows the output at clock =1, sync pulse =1, correlation is obtained between transmitted and received pulse at count 432, tx\_out =1, rx\_in =1, and obstacles is detected

## MATLAB simulation results

### PN-sequences & their behaviour analysis under automotive application conditions

PRBS or Pseudo Random Binary Sequence is essentially a random sequence of binary numbers. It is random in a sense that the value of an element of the sequence is independent of the values of any of the other elements. It is 'pseudo' because it is deterministic and after N elements it starts to repeat itself, unlike real random sequences. Examples of random sequences are radioactive decay and white noise. The implementation of PRBS generator is based on the linear feedback shift register, which consists of 'n' master slave flip-flops. The PRBS generator produces a predefined sequence of 1's and 0's, with 1 and 0 occurring with the same probability.

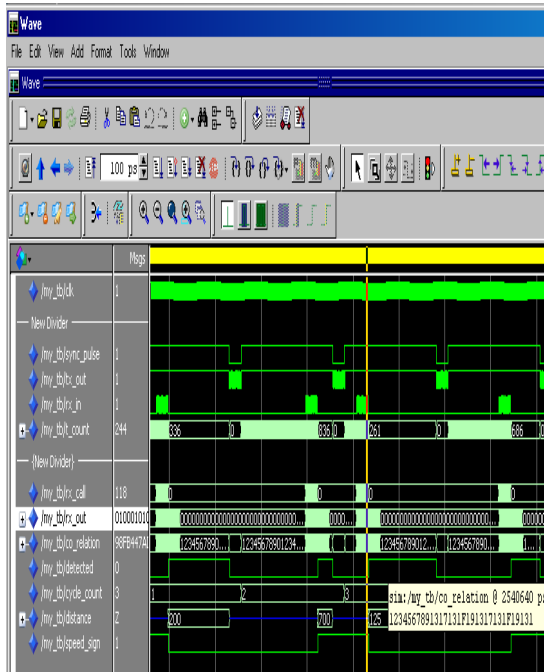


Fig. shows the output at clock =1, sync pulse =1, correlation is obtained between transmitted and received pulse at count 244,tx\_out =1,rx\_in =1, and obstacles is detected and Obtained Output at correlation 2540640ps with obstacle moving towards other obstacles

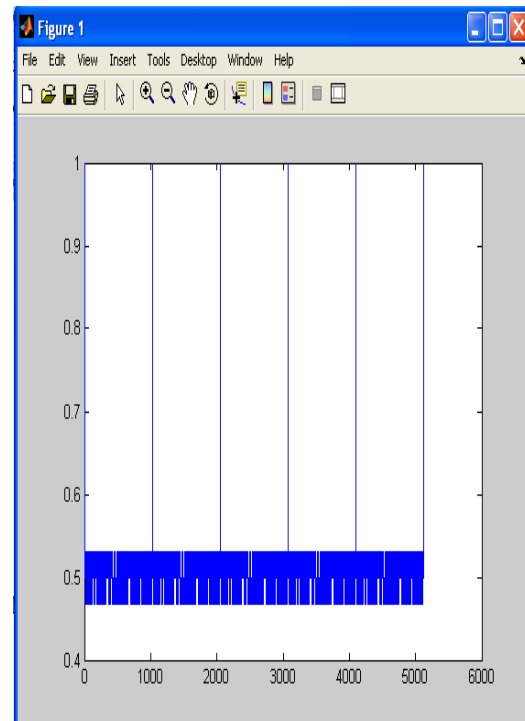


Fig. output of correlation of result of correlation of 1 and 2 with result of correlation 3 and 4 gs\_seq\_out and gs\_seq\_out\_1

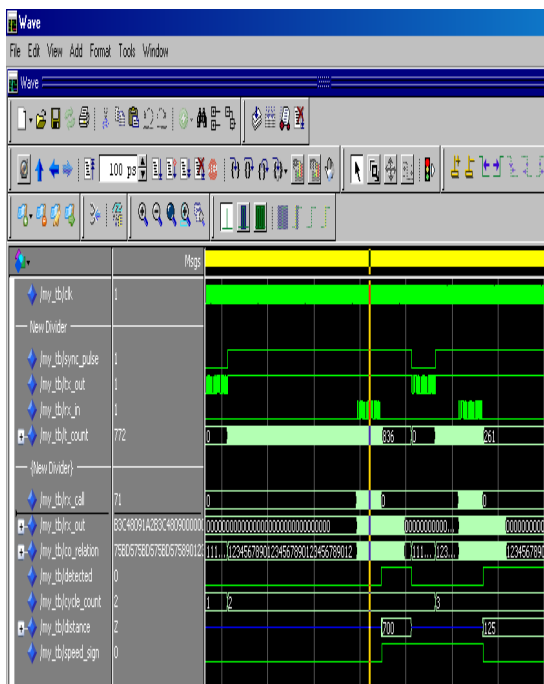


Fig. shows the output at clock =1, sync pulse =1, correlation is obtained between both pulses at count 244,tx\_out =1,rx\_in =1, and obstacles is detected with obstacles moving away from other obstacles

The above simulation results are generated for 1024 bit long PN-sequence from the simulation results we can conclude that the m-sequence codes shows good auto correlation value even in presence of large noise but it shows some peaks with other m-sequences which is not acceptable for automotive applications.

Some other important conclusions drawn by simulation are:

1. Best possible periodic autocorrelation (Minimizing out of phase autocorrelation).
2. The number of m-sequences is small.
3. Some m-sequence pairs have large cross-correlation values.

The point 2 & 3 of the above are not acceptable for our case. Therefore we consider GOLD sequences

### Result with noise of 10db in PRBS and Gold sequence

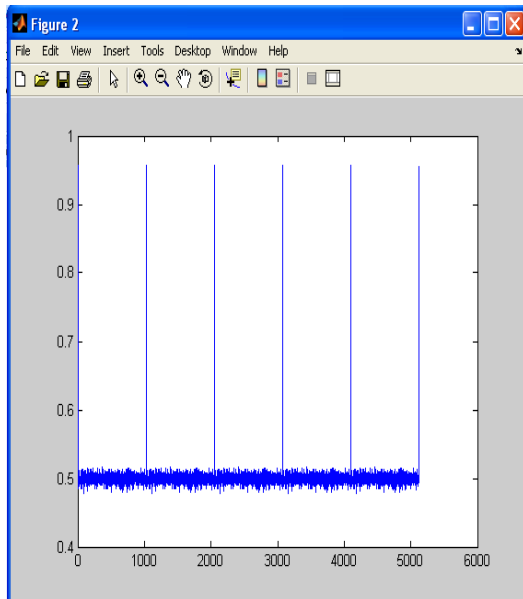


Fig. output of correlation of pn sequence as xor\_sum\_pn

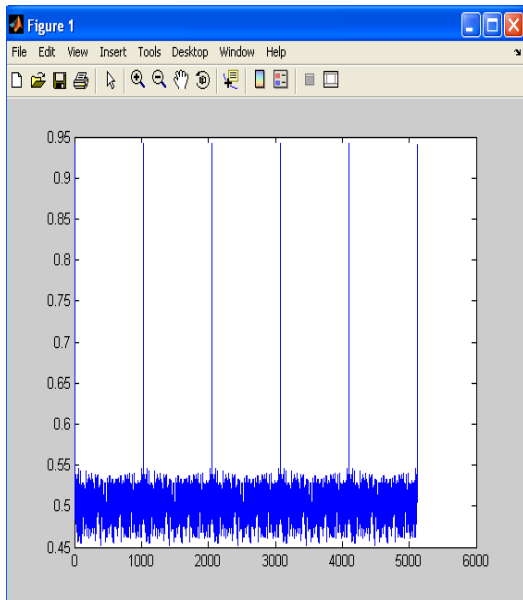


Fig. output of correlation of gold sequence as xor\_sum\_gs

### Result for different pn sequence for PRBS and Gold sequence

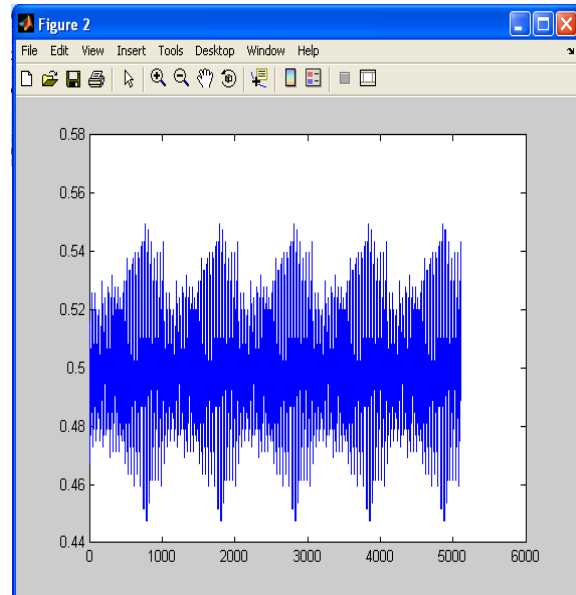


Fig. output of correlation of pn sequence as xor\_sum\_pn

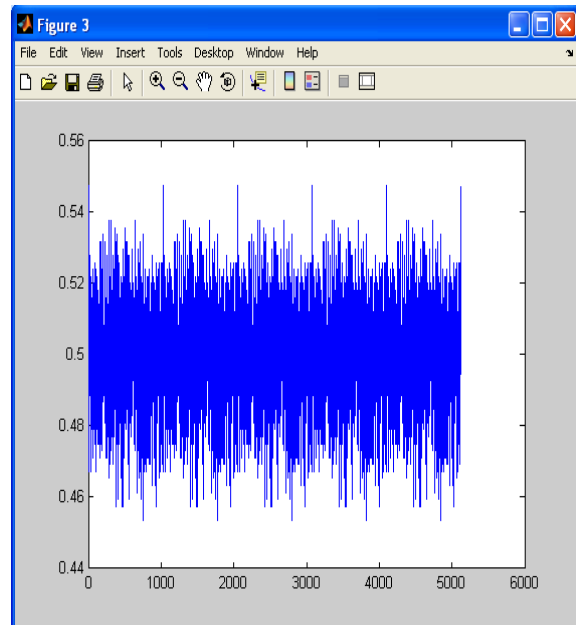


Fig. output as correlation of gold sequence as xor\_sum\_gs

The above simulation results are generated for 1024 bit long gold-sequence from the simulation results we can conclude that the gold-sequence codes shows better auto correlation value even in presence of large noise in comparison with m-sequences also it shows no peaks with other gold-

sequences which makes it better choice for automotive applications. Some other important conclusions drawn by simulation are:

1. Greater number of sequences than m-sequences.
2. Good-sequence pairs have no peaks on cross-correlation values.

All the points mentioned above makes it a good choice for our system. Hence in MATLAB we can proof the mathematical concept of PRBS which is simulated by VHDL.

**Comparisons**

S.No.	Parameter	Past Work	Present Work
1	Shift Register	128 bit	128 bit
2	Gates	128 bit Multiplier	128 bit XOR
3	No of Gates	Need More Gates	Need Less Gates
4	Speed	Slow Speed	High Speed
5	Resolution	4/12 bit	Programmable 1 to 127 bit
6	ROM	128 bit	128 bit
7	Code Line	15,000 lines	408 lines
8	Requirement of ALU and Register	7105 only for Correlator	6461 for Complete Circuit
9	Power	Required High Power	Required Less Power
10	Economy	High Cost	Low Cost

Table 2. Comparisons of Past and Present Work

**Conclusion**

In this paper we observe that we need a solution for detection in presence of noise as well in present of other signals & according to analysis of the simulation results shows that the gold codes gives better performance in presence of noise & other interfering radar signals although it needs larger number of gates hence its implementation on FPGA could increase the cost slightly but considering overall performance its better choice.

After a short state of the art on previous works car

anti-collision systems, we have described the principle of a distance measurement with correlation radar and gave our contributions on real time implementation of this radar. Many improvements were performed on the correlator architecture. This concerns optimized multipliers and improvements on adder layers. A particular attention was paid to our correlator generator. The major interest of the latter is that it is able to generate the VHDL code of the correlator including all its components, in an automatic way.

The next points give some advantages of the correlator generator:

- Fast synthesis: correlator synthesis becomes very fast and easy (the generator executes in less than a second),

- A flexible tool: to generate a new correlator, we only need to enter the desired correlator parameters such as random sequence length or data bus width, etc.

- Robustness: if an error occurs in the synthesis, it is much more efficient and easier to fix it once on the correlator generator than to do it in each file of the whole project.

The correlation was implemented on an FPGA for real time application. Two tests were performed to check the good functioning of the VHDL code generator and the correlator itself. In the second test a distance measurement was performed. The results confirmed the good functioning of the correlator and the correlator generator.

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