Literature Review for Designing Walsh Pattern Generator

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Abstract

This paper discussed literature review of different authors who tried to design a Walsh Pattern Generator. In the recent world Walsh pattern generator has major contribution in signal processing, communications system and other associated applications. Walsh pattern generator is a versatile hardware unit which contributes in the transition from sine/cosine functions to other complete systems of orthogonal functions means equivalent transition from linear, time-invariant components to linear, time-variable components. Normally Walsh pattern generators can be designed by Hadamard matrices algorithm which can be implemented using VHDL and Verilog Languages.

Keywords: Algorithm, Generator, Pattern, VHDL, Walsh

I. INTRODUCTION

Walsh functions and transforms are key analytical tools for signal processing applications, implementing digital image processing and statistical analysis to solve differential equations. The Walsh functions have a trains of square pulses having transitions at fix intervals of a unit function time step. The function WAL(i,k) represents a waveform, known as Walsh Pattern, as a function of time k with i transitions over the period of the function defined as Sequency function. These parameter ‘n’ can be interpreted as “one half the number of zero crossings per unit time. The term i is known as the normalized sequency or sequency. The equation of an index n, i=log₂ n. There are 2^n Walsh functions of length 2^n. Also, within the set of 2^n functions, there is one function of zero sequency, one of (normalized) sequency 2^n-1, and one pair (odd and even) of each (normalized) sequency from 1 to 2^n-1 – 1.

II. LITERATURE REVIEW

P.W.Besslich (1973) has proposed synchronous counter based technique. The design based on the counters has given the set of Walsh functions. Further the design realized for the least possible error in orthogonality. The flip-flop of the counter generates synchronously one particular Walsh function in the interval 1 of normalized time during one cycle of counting. The usual design procedures for synchronous counters are not applicable because of the large number of logic variables. Using a two dimensional plot of the enabling inputs, it turns out that the T flip-flop is the most suitable type. It is shown that by using the symmetry properties of the enabling input patterns for a generator consisting of n T flip-flops, only (log2 n) - 1 standard time sequences, from which the remaining could be derived, need be generated. These time sequences can be easily obtained by decoding the outputs of those flip-flops generating the subset of Rademacher functions. [1]

Shuja A. Abbasi (2002) worked on realization of Rademacher functions and Walsh functions using high level design techniques targeted to Xilinx FPGAs. The application of these functions in generating digital and analog sinusoidal waves on the same chip also has been demonstrated. Xilinx Foundation Series suite of software was used for hardware realization. The design was targeted to Xilinx XC4000 series FPGAs. The VHDL codes were first written for Rademacher functions. It was observed that these functions can be realized as the output of a synchronous binary counter. Codes for Walsh functions were then written based upon the aforesaid expressions. The sinusoidal function in digital form using 16 bits was realized using the calculated values of the expansion coefficients. Each entity was separately simulated after synthesis using FPGA Express synthesis tool from SYNOPSIS. The Rademacher functions, the Walsh functions and the sinusoidal functions were thoroughly studied before and after implementation on several FPGAs. Timing analysis was performed in each case to determine the critical path and the maximum frequency of operation. [2]

B.J. Falkowski and T. Sasao (2005) jointly worked on an algorithm to generate Walsh functions in different orderings consists of Harmuth, Hadamard, Paley and Strict sequency. By the analysis of the properties and mutual relations among these four orderings, the authors found a unified approach to generate any of the orderings from the primary set of Rademacher functions. By using these properties, the authors developed a programmable Walsh function generator for 64 outputs by both field programmable gate arrays and lookup table cascades to estimate the amount of hardware and performance. Such a programmable Walsh function generator can be used in VLBI experiments in Radio Astronomy field. [3]
Yukihiro Iguchi (2005) presented a method to compute a fragment of the Walsh coefficients of logic functions using hardware. The first step uses Walsh transformation tree based a method to compute Walsh coefficients and then developed the hardware realization for the Walsh tree. FPGA implementations show their feasibility up to n=14 The FPGA realization is at least times faster than a software implementation on a microprocessor. Such hardware is applicable for the fault diagnosis of semiconductor memories and Boolean matching. [4]

J. Granul (1978) presented a paper describing that Walsh functions can be used to advantage to perform phase switching in antenna arrays used for radio mapping of the sky by Fourier synthesis. This paper also describes the reason for phase switching, the advantage of using Walsh functions, and the implementation of these ideas in the Very Large Array (VLA) program of the National Radio Astronomy Observatory. The sequences of the Walsh functions are sufficiently high compared with the phase variations caused by the delay tracking that the unwanted outputs are satisfactorily suppressed. [5]

III. CONCLUSION

After reviewing above papers we can say that, Walsh pattern generator must be better designed using latest industrial trend and devices available. Present scenario and available programmable devices can help to construct and build more accurate and coherent generator than conventional electronics components. Also programmable devices such as CPLD and FPGA can be easily programmed for required length of the Walsh pattern with programmable frequency and sequency selection easily.

REFERENCES