# A High Speed Block Convolution using Ancient Indian Vedic Mathematics

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***Abstract***

*In Digital Signal Processing applications, the convolution with a very long sequence is often required. In order to compute convolution of long sequence, Overlap-Add method (OLA) and Overlap-Save method (OLS) method can be considered. The OLA and OLS are well known efficient schemes for high-order filtering. The most commonly used implementation for digital filtering algorithms are Digital Signal Processors, special purpose Digital Filtering chips and Application Specific Integrated Circuits (ASICs) for large volumes. In this paper, a high performance, high throughput and area efficient architecture for the Field Programmable Gate Array (FPGAs) implementation of block convolution process is proposed. The most significant aspect of the proposed method is the development of a multiplier architecture based on vertical and crosswise structure of Ancient Indian Vedic Mathematics and embedding it in OLA and OLS methods for improved efficiency. The coding is done in VHDL (Very High Speed Integrated Circuits Hardware Description Language) and the FPGA synthesis is done using Xilinx Spartan library. The results shows that OLA and OLS method of block convolution implemented using Vedic multiplication is efficient in terms of area/speed compared to its implementation using conventional multiplier architectures.*

## 1. Introduction

With the latest advancement of VLSI technology the demand for portable and embedded Digital Signal Processing (DSP) systems has increased efficiently**.** Using programmable devices for DSP applications could narrow the gap between the flexibility of General Purpose Processor(GPP), Programmable DSP(PDSP). FPGAs are being increasingly used for variety of computationally intensive applications. In digital signal processing convolution is a fundamental computation that is ubiquitous in many application areas. Computing linear convolution by a sequence of circular or periodic convolutions concerning suitable finite blocks of the input data is a well-known method for efficiently computing convolution called Fast Convolution[7]. In filtering a speech waveform, the input signal is of indefinite duration theoretically processing, such a scheme is often cumbersome. As it is well known, if the output of a filter is computed for a block of samples at once, the number of operations can be saved. The modified over-lap add algorithm[1] executes faster than the traditional algorithm but incurs an additional delay of samples which are implemented using Matlab. The extended overlap-add method and the extended overlap-save method[3], utilizing FFT is more efficient than the polyphase structure but the implementation leads to high efficiency when employing a high-order FIR filter. The uniformly partitioned fast block convolution algorithm[5] with arbitrary delay performs the fast block convolution with the same cost as the conventional method at $2^n$ delays, and also performs arbitrary length other than $2^n$ with additional moderate computations

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