

SinCore Facts

- **Design File Formats:** VHDL
 - **Verification:** Test Bench
 - **Instantiation Templates:** VHDL
 - **Simulation Tool Used:** Vivado Simulator (XSIM)
 - **Support Provided by:** Barzak
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Features

- Available under terms of the Barzak IP License
 - 16-bit unsigned input and output function
 - Function $y = \sin(\pi/2 \cdot x)$
 - Input range: $0 < x < 1$, Output range: $0 < y < 1$
 - 4-stage pipelined architecture
 - Accuracy of 1 LSB error, 0.00001525878
 - Results available every clock cycle after four cycles
 - Fully configurable and synthesizable
 - Implemented using Harmonized Parabolic Synthesis for optimal accuracy
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Example Implementation Statistics for Xilinx FPGA

Family	Example device	Fmax(Mhz)	LUT	FF	DSP	BRAM
Zynq Ultrascale	XCZU7EV-3	361.272	206	103	4	0.5

Architecture Overview

- **4 stage pipeline unit:** The computational unit is divided into four stages. Each stage is set by the divided computational formula of Harmonized Parabolic Synthesis.

Core I/O Signals

Signal	Direction	Description
clk	Input	Global system clock
datai[31:0]	Input	32-bit input data bus
datao[31:0]	Output	32-bit output data bus

Applications

- Embedded arithmetic processing
- Real-time signal processing(Fourier Transform & Filters)
- Computer graphics
- Financial Modeling
- Telecommunications

Verification Methods

The Barzak Sin core has been verified in simulation using fully automated testbenches. The sin result is evaluated for 2^{16} (65536) inputs (every conceivable mantissa value).

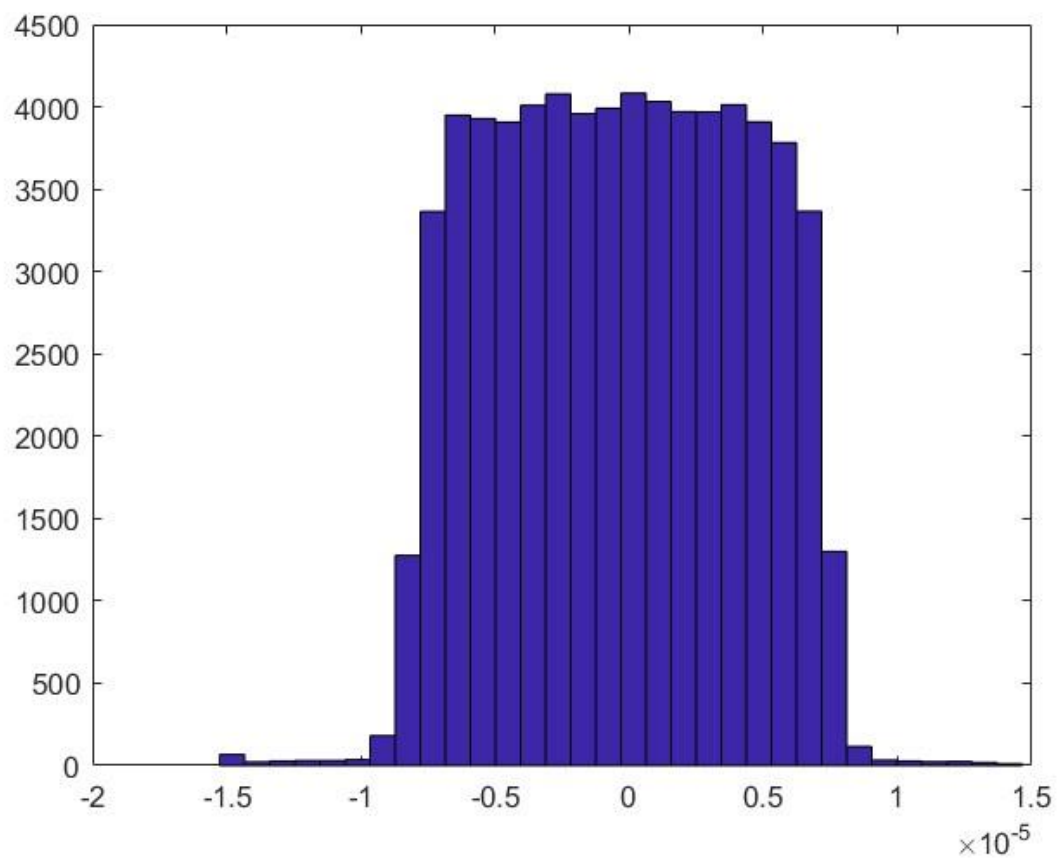
Additionally, verification was performed using an FPGA testing board, comparing computed sin results with a PC-based 16-bit unsigned fixed-point processor.

Performance

The 16-bit Sin function core achieves an accuracy of ± 1 Least Significant Bit (LSB), corresponding to a maximum error of approximately 0.00001525878.

The figure below shows the distribution of computation errors over all 65,536 input values. The error distribution is centered around zero and approximates a normal

distribution, indicating that the majority of errors are small and symmetrically spread across the full input range.



Related Information

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