ABSTRACT

Many natural processes exhibit exponential decay and, consequently, computational scientists make extensive use of $e^{-x}$ in computer simulation experiments. While it is common to implement transcendental functions (sine, cosine, exponentiation, etc.) in hardware using the well-known CORDIC algorithm, many contemporary FPGA implementations either use fixed point or reduced precision floating-point operations (which suffers from a high average/mean error). Unfortunately, these solutions are unacceptable for many computational scientists who require the accuracy of double-precision values.

This paper presents a direct implementation of an IEEE 754 double-precision $e^{-x}$ FPGA core to support computational science applications. The design is similar to CORDIC but has been modified to specifically support exponentiation; it is pipelined and parallel to efficiently handle large vectors of parameters. Compared to solutions described in the literature, it consumes lesser logical gates, enabling more $e^{-x}$ cores per FPGA. The paper compares the implementation to the current prevailing approaches. Results show that the implementation on the Virtex 4 XC4VFX60 FPGA achieves a correct precise double-precision $e^{-x}$ values, with a high throughput.

Categories and Subject Descriptors

B.2.1 [Hardware]: Arithmetic and Logic Structures Design Styles [Parallel, Pipeline]; C.3.e [Computer Systems Organization]: Special-Purpose and Application-Based Systems Reconfigurable hardware

Keywords

FPGA, CORDIC, Exponential core

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