**LOW-POWER APPROXIMATE MULTIPLIERS USING ENCODED PARTIAL PRODUCTS AND APPROXIMATE COMPRESSORS**

**Abstract:**

Approximate computing has been considered to improve the accuracy-performance trade-off in errortolerant applications. For many of these applications, multiplication is a key arithmetic operation. Given that approximate compressors are a key element in the design of power-efficient approximate multipliers, we first propose an initial approximate 4:2 compressor that introduces a rather large error to the output. However, the number of faulty rows in the compressor’s truth table is significantly reduced by encoding its inputs using generate and propagate signals. Based on this improved compressor, two 4×4 multipliers are designed with different accuracies and then are used as building blocks for scaling up to 16×16 and 32×32 multipliers. According to the mean relative error distance (MRED), the most accurate of the proposed 16×16 unsigned designs has a 44% smaller power-delay product (PDP) compared to other designs with comparable accuracy. The radix-4 signed Booth multiplier constructed using the proposed compressor achieves a 52% reduction in the PDP-MRED product compared to other approximate Booth multipliers with comparable accuracy. The proposed multipliers outperform other approximate designs in image sharpening and joint photographic experts group (JPEG) applications by achieving higher quality outputs with lower power consumptions. For the first time, we show the applicability and practicality of approximate multipliers in multiple-input multiple-output (MIMO) antenna communication systems with error control coding.

**Index Terms**—approximate computing, multiplier, MIMO, image sharpening, JPEG.

**TOOLS:**

1. **XilinxISE 14.7**

**LANGUAGE:**

1. **VerilogHDL**