

Formal Methods in Arithmetic Circuit Verification: a brief History and Look into the Future

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Abstract

The last few decades marked an explosive growth in the number and importance of cyber-physical and embedded systems. As more and more of those systems become security- and safety-critical, assuring functional correctness and dependability of their digital hardware implementation became critical. Essential elements of those systems are arithmetic circuits: different types of adders, multipliers, and dividers that need to be efficiently designed and optimized for area, delay and power. These circuits become more and more complex, containing millions of logic gates; this makes them extremely error-prone, and require advanced simulation, verification and testing to guarantee their integrity. This keynote addresses some of these issues and concentrates on formal verification of hardware implementation of arithmetic circuits.

The presentation gives a brief overview of modern methods used in arithmetic circuit verification, including theorem proving, Boolean methods, satisfiability, and symbolic computer algebra. It shows how these methods evolved from being based on pure mathematical models to practical engineering solutions. It discusses challenges they face and offers a look into the future.

Biography

Maciej Ciesielski is Professor in the Department of Electrical & Computer Engineering at the University of Massachusetts (UMass), Amherst. He received M.S. in Electrical Engineering from Warsaw Technical University, Poland, in 1974 and Ph.D. in Electrical Engineering from the University of Rochester, N.Y. in 1983. From 1983 to 1986 he worked at GTE Laboratories on a silicon compiler project. He joined the University of Massachusetts in 1987; during his tenure at UMass he graduated 21 Ph.D. students. His research interest is in the area of electronic design automation, and specifically in logic and high level synthesis and verification of VLSI circuits. In 2008 he received Doctorate Honoris Causa from the Universite de Bretagne Sud, Lorient, France, for contributions to the development of EDA tools for high level synthesis. He published over 120 scientific articles and his work has over 3,250 citations. He was a general chair of ICCD 2020 and 2021. Dr. Ciesielski is an IEEE Life Fellow.