Optimal Resilience for Short-Circuit Noise in Formulas

Abstract:

We show an efficient method for converting a logic circuit of gates with fan-out 1 into an equivalent circuit that works even if some fraction of its gates are short-circuit ed, i.e., their output is short-circuited to one of their inputs. Our conversion can be applied to any circuit with fan-in \( k \geq 2 \), yielding a resilient circuit whose size is polynomial in the size of the (non-resilient) input circuit.

The resilient circuit gives the correct output as long as less than \( 1/3 \) of the gates in any of its input-to-output paths are corrupted. Furthermore, we prove that a resilience level of \( 1/3 \) is optimal (maximal) for this type of faulty gates. This fully answers an open question by Kalai et al. (FOCS 2012).

Joint work with Mark Braverman and Michael Yitayew.