Towards Optimal Deterministic Coding for Interactive Communication.
Noga Ron-Zewi, IAS

We show an efficient, deterministic interactive coding scheme that simulates any interactive protocol under random errors with nearly optimal parameters.

Specifically, our coding scheme achieves a communication rate of $1 - \delta(\sqrt{\epsilon})$ and a failure probability of $\exp(-n/\log n)$, where $n$ is the protocol length and each bit is flipped independently with constant probability $\epsilon$. Prior to our work, all nontrivial deterministic schemes (either efficient or not) had a rate bounded away from 1. Furthermore, the best failure probability achievable by an efficient deterministic scheme with constant rate was only quasi-polynomial, i.e., of the form $\exp(-\text{polylog}(n))$ (Braverman, ITCS 2012). The rate of our scheme is essentially optimal (up to poly-logarithmic factors) by a result of Kol and Raz (STOC 2013).

A central contribution in deriving our coding scheme is a novel code-concatenation scheme, a notion standard in coding theory that we adapt for the interactive setting. Essential to our concatenation approach is an explicit, efficiently encodable and decodable linear tree code of sufficiently good parameters. The fact that our tree code is linear, and in particular can be made systematic, turns out to play an important role in our concatenation scheme. We use this tree code as the "outer code" in the concatenation scheme. The necessary deterministic "inner code" is achieved by a nontrivial derandomization of a randomized interactive coding scheme of (Haeupler, STOC 2014).

This is a joint work with Ran Gelles, Bernhard Haeupler, Gillat Kol and Avi Wigderson.