An Explicit Construction of a High-Rate Minimum Storage Regenerating Code with Low Sub-Packetization Level and Selectable Repair Degree

Birenjith Sasidharan, Myna Vajha, and P. Vijay Kumar
Department of Electrical Communication Engineering, Indian Institute of Science, Bangalore.
Email: {biren, myna, vijay}@ece.iisc.ernet.in

Abstract

Regenerating codes are a class of erasure codes that are efficient in terms of the amount of data download needed to repair a failed node. These are codes over the vector alphabet $\mathbb{F}_q^\alpha$, where $\mathbb{F}_q$ is the size of the underlying finite field over which all operations are carried out, and α is termed the sub-packetization level. Two requirements are placed on a regenerating code, namely (a) that the entire file can be recovered by connecting to any k nodes and secondly (b) that a failed node can be repaired by connecting to any d nodes and downloading $\beta < \alpha$ symbols from each of the d helper nodes contacted. Given parameter set $\{(n, k, d), (\alpha, \beta), \mathbb{F}_q\}$, the cut-set bound from network coding tells us the maximum number B of message symbols corresponding to a single data file.

Within the class of regenerating codes, there is a tradeoff between the amount $n\alpha$ of storage space needed and the bandwidth $d\beta$ needed to repair a failed node. At one end of this tradeoff are the so-called minimum storage regenerating (MSR) codes, which turn out to be a subclass of the class of maximum distance separable (MDS) codes. In this paper, we will present the explicit construction of a high-rate regenerating code where d can be selected to take on any value lying between k and n. In comparison with prior constructions, the sub-packetization level is significantly lower. Connections and comparisons with prior constructions will also be made.

Time permitting, we will also briefly present recent results on locally recoverable codes for multiple erasures having highest possible rate.