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Construction of Network Error Correction Codes in Packet Networks

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Recently, network error correction coding (NEC) has been studied extensively. Several bounds in classical coding theory have been extended to network error correction coding, especially the Singleton bound. In this paper, following the research line using the extended global encoding kernels proposed in \cite{zhang-correction}, the refined Singleton bound of NEC can be proved more explicitly. Moreover, we give a constructive proof of the attainability of this bound and indicate that the required field size for the existence of network maximum distance separable (MDS) codes can become smaller further. By this proof, an algorithm is proposed to construct general linear network error correction codes including the linear network error correction MDS codes. Finally, we study the error correction capability of random linear network error correction coding. Motivated partly by the performance analysis of random linear network coding \cite{Ho-etc-random}, we evaluate the different failure probabilities defined in this paper in order to analyze the performance of random linear network error correction coding. Several upper bounds on these probabilities are obtained and they show that these probabilities will approach to zero as the size of the base field goes to infinity. Using these upper bounds, we slightly improve on the probability mass function of the minimum distance of random linear network error correction codes in \cite{zhang-random}, as well as the upper bound on the field size required for the existence of linear network error correction codes with degradation at most d.

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