The Rate/Performance Tradeoffs of Focused Error Control Codes

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Let $B$ be a set of non-zero elements of $F_q (q > 2)$; we say a code is $(t_1, t_2)$-focused on $B$ if it can correct up to $t_1 + t_2$ errors provided at most $t_1$ of those errors lie outside $B$. The strategy is to offer different levels of protection against “common” errors – those in $B$ – and “uncommon” errors. (The motivating example: correction of single-bit-per-byte errors with codes over $F_{2^b}$.)

This talk will compare the performance and rates of $(t_1, t_2)$-focused codes with those of traditional $t_1 + t_2$-error correcting codes. We show that, at high SNR, if a channel is sufficiently “skewed” – that is, if the noise character is $Z$ and $P\{Z \notin B|Z \neq 0\} < \gamma_{crit}$ – then the performance of a $(t_1, t_2)$-focused code is essentially identical to that of a $t_1 + t_2$-error correcting code; this claim is derived analytically and verified by simulation results. Since $(t_1, t_2)$-focused codes can be constructed with higher rates than can $t_1 + t_2$-error correcting codes, they offer for these “skewed” channels new advantages in terms of rate and/or performance. We include in the talk an analysis of the tradeoffs offered by focused codes for $M$-ary PSK and $M$-ary ASK modulation schemes.