Abstract

Turbo Decoder Soft-ARQ and SNR Estimation

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In 1948, Claude E. Shannon published what is now a hallmark of modern communication technology, 'A Mathematical Theory for Modern Theory of Communication'. In this paper he concluded that as long as the transmission rate is less than the channel capacity, a communication system always exists which can attain an arbitrarily low bit error rate. For almost 50 years, researchers inspired by the Shannon limit theory dedicated their efforts to finding communication systems capable of such high performance.

In 1993 Berrou, Glavieux and Thitimajshima presented their breakthrough to the world, which they called 'Turbo Codes'. Turbo codes are capable of phenomenal performance and today at 0.5 dB away from the Shannon limit, the quest for improved error control coding techniques continues.

In this thesis, the structure and function of turbo codes are investigated to gain a working knowledge of this very powerful error-control coding scheme. Probabilities iteratively calculated internally to the turbo decoder are used to develop an error detection criteria. This leads to the creation of a unique

automatic repeat request (ARQ) scheme. This novel scheme significantly improves the already phenomenal performance of a typical turbo code, with a penalty of a reduction in the information throughput.

The internal probabilities are utilized to devise a channel signal-to-noise (SNR) estimation scheme. The turbo coded system is switched from the in-synchronization state to the off-synchronization state and the behavior of internal probabilities is characterized by the channel SNR. This is exploited within a one-dimensional random walk to develop a new SNR estimation scheme.