

A new equalizer for Intersymbol Interference (ISI) communication channels with single carrier transmission
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The Technology

A new equalizer for Intersymbol Interference (ISI) communication channels with single carrier transmission. This equalizer, termed "Integer-Forcing" equalizer, allows to simply and effectively combine decision feedback equalization (DFE) with channel coding (error correcting codes). This is done by transmitting codewords from a cyclic code and equalizing the ISI channel into a channel with an impulse response where all taps are integer-valued. The output of the equalized channel is then itself a codeword. This codeword is first decoded, and then the transmitted codeword is recovered from it. This technology allows in many cases to transmit with rates close to the capacity with low error probabilities.

The Need

ISI channels appear in almost any communication system. When single carrier transmission is used equalization is a very important issue. Most systems use either a linear (Zero-Forcing or MMSE) equalizer or a DFE equalizer. The linear equalizer often incurs a large noise amplification, which in turn reduces the transmission rate. The noise amplification of the Integer-Forcing equalizer, which works with (roughly) the same complexity as the linear equalizer, is always smaller.

The DFE equalizer suffers from error propagation, and does not combine well with error correcting codes (i.e., error correcting codes are only applied after the error propagation have already occurred). The Integer-Forcing equalizer does not suffer from error propagation at all and utilizes the error correcting code effectively.

Potential Application

The Integer-Forcing equalizer is applicable for any communication system with single carrier transmission, operating at rates that are not very small (say, above 1 bit/symbol). It is most effective when the ISI channel is difficult for equalization, i.e., when the linear equalizer induces a large noise amplification.

Advantages

The complexity of the Integer-Forcing equalizer is roughly the same as that of the linear equalizer, and the building blocks are standard components that are often implemented in many communication systems.

The Integer-Forcing equalizer completely eliminates the error propagation problem of the DFE, and often performs much better than the linear equalizer.

Stage of Development

The theoretical work has been completed

Patents

One Patent filed WO 2011/092697

Supporting Publications

Or Ordentlich and Uri Erez, "Cyclic-Coded Integer-Forcing Equalization, IEEE Transactions on Information Theory, vol. 58, no. 9, pp. 5804-5815, Sept. 2012

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