Towardss next Generation DVB-T

Terrestrial digital TV broadcasting (DVB-T) is the most popular way to distribute TV in Europe and many other parts of the world. However, its success has been under pressure after the introduction of the MPE/G4 compression standard and the new digital video broadcasting standard for satellite transmissions, DVB-S2, which are driving the first adoption of high definition television (HDTV) on satellite and cable networks.

Therefore, in 2006, the terrestrial TV broadcasting community felt the need for an improved system. DVB-T2 is a second generation terrestrial transmission system for digital television broadcasting. It builds on the technologies used as part of the first-generation system. DVB-T, developed over a decade ago. DVB-T2 extends the range of most of the parameters of DVB-T and significantly reduces overhead to build a system with a throughput close to theoretical channel capacity, with the best possible ruggedness of transmission. The key motivation behind this new standard was the desire in several European countries to offer HDTV services as efficiently and effectively as possible. The move to HDTV inevitably brings with it a change of source coding, compression techniques used as part of the first generation terrestrial transmission system for digital television broadcasting. It builds on the technologies used as part of the first-generation system. DVB-T, developed over a decade ago. DVB-T2 extends the range of most of the parameters of DVB-T and significantly reduces overhead to build a system with a throughput close to theoretical channel capacity, with the best possible ruggedness of transmission. The key motivation behind this new standard was the desire in several European countries to offer HDTV services as efficiently and effectively as possible. The move to HDTV inevitably brings with it a change of source coding, compression

Adaptive Channel Estimation for DVB-T / T2

Unlike differential transmission schemes are used, which however decrease the spectral efficiency, channel estimation is needed for equalization and decoding of error protection codes. Pilot-based techniques provide that specific positions of the OFDM block (pilot subcarriers) are used to transmit symbols known at the receiver: the channel is first estimated at pilot positions and then interpolated on all subcarriers. When pilots are in different positions at each OFDM block, time interpolation (TI) is performed to exploit the correlation among channels at different OFDM blocks and then frequency interpolation allows to recover the channel response on all subcarriers.

We focus on the use of this special frame structure for synchronization and signal acquisition. The DVB-T2 implementation guidelines suggest a technique for time and frequency synchronization, exploiting the correlation among the main part of the received P1 symbol and the two guard intervals. We denote this technique as correlation-based synchronization (CBS) scheme. However, this technique has significant limitations even on a very simple two-taps channel that is commonly considered for assessing the performance of DVB-T2. For this reason, we first propose a new detection technique, still based on the correlation approach, which overcomes the limitations of CBS, and finally, we provide an analytical description of the optimal estimator in the Maximum-Likelihood (ML) sense.

CBS signals and waveforms

Receiving Signal:

\[ r_n = \sum_{m=-\infty}^{\infty} x_n - \sum_{m=-\infty}^{\infty} n \]  

Correlation Signals:

\[ n_m = r_{n+m} - \sum_{m=-\infty}^{\infty} n \]

Averages:

\[ r_n = \sum_{m=-\infty}^{\infty} x_n - \sum_{m=-\infty}^{\infty} n \]

Output Wave (AWGN):

Output Waveform (Two-Taps):

1st Alternative: Slope-Based Synchronization

\[ r_n = a_n + b_n \]

\[ \text{Averaging filter} \]

2nd Alternative: Maximum Likelihood Scheme

\[ r_n = a_n + b_n \]

\[ \text{Averaging filter} \]

Conclusions

- Simulations results reporting the detection probability of P1 symbol, show that SBS outperforms CBS.
- Due to complexity issues rising up while implementing ML scheme, a suboptimal solution has been devised. Simulation results provide even better performance than SBS.