COMPRESSED SENSING BASED MODIFIED ORTHOGONAL MATCHING PURSUIT IN DTTV SYSTEMS

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Abstract - *Digital Terrestrial Television(DTTV) system offers television services with excellent image and sound quality. The technique used here is Modified Orthogonal Matching Pursuit (MOMP) which is used to calculate the impulse response in time domain by compressed sensing (CS) channel estimation. The Compressed Sensing(CS) based channel estimation(CE) is used at the receiver to eliminate spares information. Denoising is very important, in a Compressed Sensing(CS) based channel estimation, to improve the quality of received signals using a determined amount of data. Essentially, it is a challenging problem to remove the noise because of the high frequency characteristics of the noise while preserving data signals. Thresholding is used to eliminate the effect of noise in this Compressed Sensing based channel estimation, and efficiently improve the data signals. The BER can be calculated by using the impulse response of the DTTV system. Simulation results shows that the BER decreases, if the received signal power from different transmitters are almost equal.*

Key Words: Digital Terrestrial Television(DTTV), Compressed Sensing(CS), Modified Orthogonal Matching Pursuit(MOMP), Channel Estimation(CE),Orthogonal Matching Pursuit(OMP), Bit Error Rate(BER), Signal to Noise Ratio(SNR).

1. INTRODUCTION

A signal processing scheme for perfectly reconstructing and obtaining a signal is compressed sensing (or compressive sampling or sparse sampling or compressive sensing). By finding solutions to undetermined linear systems the compressed sensing channel estimation is used. This is depend on the principle that, through optimization, the sparsity of a signal can be abused to reconstruct it from far fewer samples than needed by the Nyquist–Shannon sampling theorem. There are two conditions under which reconstruction is possible. The first one is sparsity, which needs the signal to be sparse in some domain. The second one is incoherence, which is enforced through the isometric property, which is acceptable for sparse signals.

A common goal of the engineering field of signal processing is to recover a signal from a series of sampling measurements. In general, this task is impractical because there is no way to recover a signal during the times that the signal is not estimated. Nevertheless, with prior knowledge or hypothesis about the signal, it turns out to be desirable to perfectly recover a signal from a series of estimations (acquiring this series of measurements is called sampling). Over time, engineers have enhanced their understanding of which hypothesis is practical and how they can be generalized.

An early development in signal processing was the Nyquist–Shannon sampling theorem. It states that if a real signal's highest frequency is lower than half of the sampling rate (or less than the sampling rate, if the signal is complex), then the signal can be recovered perfectly by means of sins. The main idea is that with prior knowledge about necessity on the signal's frequencies, fewer samples are required to recover the signal.

2. LITERATURE SURVEY

The capability of a basis to implement a sparse representation depends on how well the signal characteristics meet the characteristics of the basis vectors. Because the vectors in the dictionary are not a directly independent set, the signal illustration in the dictionary is not unique. However, by generating a redundant dictionary, you can extend your signal in a set of vectors that conform to the time-frequency or time-scale characteristics of your signal. You are free to generate a dictionary including of the union of several bases.

For example, you can create a basis for the space of square-integral functions including of a wavelet packet basis and a local cosine basis. A wavelet packet basis is well conformed to signals with distinct behavior in different frequency intervals. A local cosine basis is well conformed to signals with distinct behavior in different time intervals. The capability to choose vectors from each of these bases highly increases your capability to sparsely represent signals with varying characteristics.

Orthogonal Matching Pursuit(OMP) is an iterative greedy algorithm. In general, the noise is present in the OMP algorithm. Standard CS algorithms have been used to reconstruct the original spectrum, such as orthogonal matching pursuit (OMP). We propose to modify the standard OMP algorithm by using prior knowledge of channel estimation (CE) to improve the reconstruction performance, thus further reducing the Bit-Error-rate.

We have introduced two Basic Pursuit (BP) based reconstruction algorithms considering prior knowledge and their limitations. To overcome these, we propose a modified OMP. There are some cooperative wideband spectrum sensing algorithms modified upon standard Compressed Sensing (CS) algorithms using shared knowledge of the users, under the assumption that there is channel to share information. Simulation shows that the modified OMP algorithm has much better reconstruction performance in mean square error (MSE).

3. METHODOLOGY

For fast Compressed Sensing of natural signal, where the original signal is divided into small blocks in the Block-based model sampling and each block is sampled independently using the same measurement operator. The image is divided into small blocks with size of N×N each in block based Compressed Sensing and sampled with the same operator. Fast Fourier transform is carried out for each block after dividing the images into blocks. Threshold is calculated according to noise level, after transforming the signal in sparse domain. The sensing process is done, after calculating the threshold and the MOMP reconstruct the noise free signal. The below fig -1 shows the receiver block diagram.

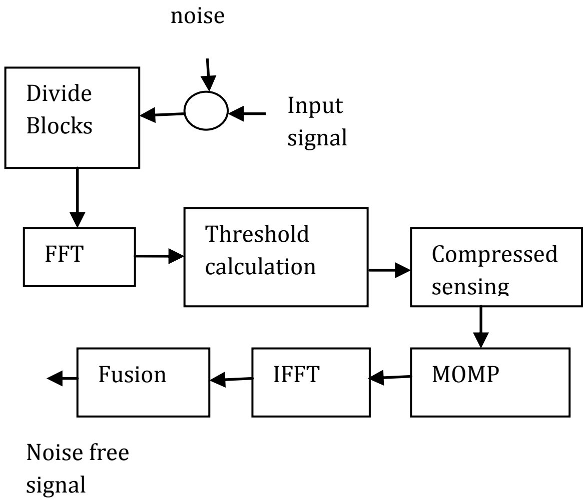
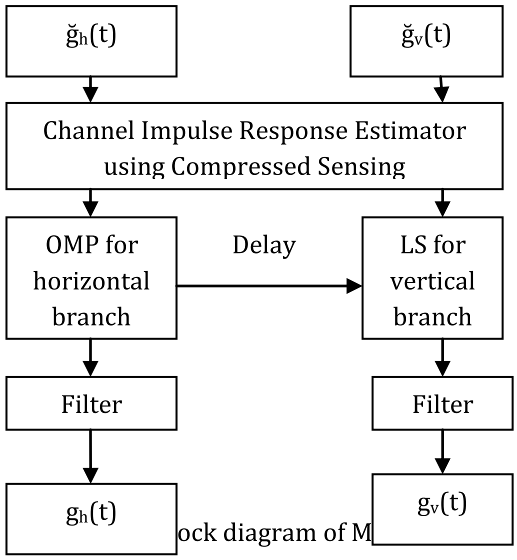


Fig -1: Receiver block diagram

4. IMPLEMENTATION

Fig -2 shows the block diagram of Modified Orthogonal Matching Pursuit, where $\breve{g}_h(t)$ and $\breve{g}_h(t)$ are horizontal and vertical branch high noise impulse responses respectively. These impulse responses are received from the receiving antennas. Compressed channel estimation is applied on both branches at the same time. After completing the channel estimation process the signal is fed to the horizontal and vertical branches separately.OMP is applied on horizontal branch for calculating gain and the delay. The delay from the horizontal branch fed to the vertical branch. Thus reduces the delay by applying the LS on vertical branch for calculating the gain. The delay is calculated only once. After calculating the delay and gain on both t he branches, filter operation is performed for further reducing unwanted signal. Finally, the low noise time domain impulse response can be obtained.



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5. RESULTS AND DISCUSSIONS

In this section, describe the simulator parameters and demonstrate, through simulation results, that the performance of our proposed STBC transmission scheme is better than that of the conventional system. 2- Rayleigh fading channel and ideal channel estimation are assumed in the simulation. Quadrature phase-shift keying (QPSK) modulation is applied.

We measured the bit error rate (BER) performance versus signal to noise ratio(SNR) for the proposed technique.

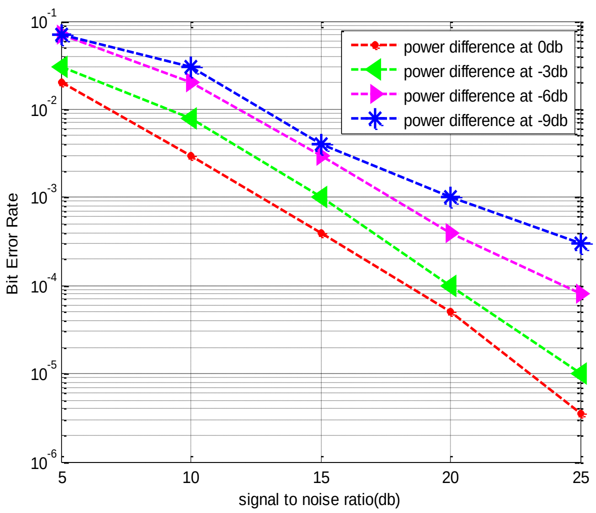

Fig -3: BER performance at transmitting end

Above fig -3 shows the Bit Error Rate (BER) performance for different power differences between the two base stations at the transmitting end. The BER performance improves if the approaches to 0 which means both base station A and B have the same signal power at the receiver.

The table -1 below shows the different power differences for both the base stations.

Table -1: Simulation results at transmitting end

Technique	Bit Error Rate(b/s)	Signal to noise ratio(db)
Power difference at 0db	0.03	10
Power difference at -3db	0.02	10
Power difference at -6db	0.001	15
Power difference at -9db	0.0004	15

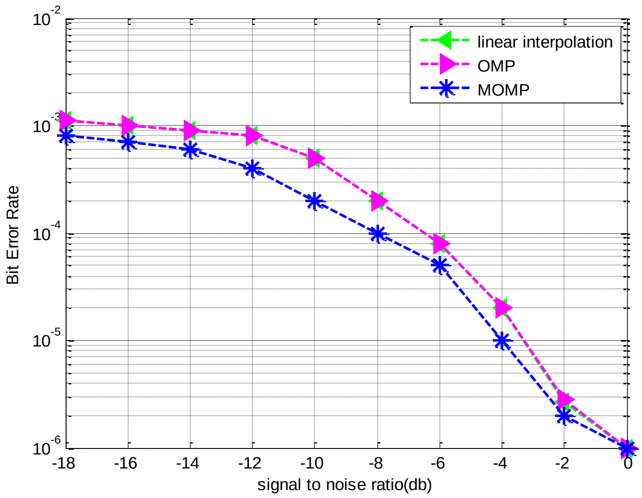

Fig -4: BER performance Vs signal to noise ratio at base station 1

The below fig -4 shows the Bit Error Rate(BER) Vs Signal to Noise ratio, if one of the base station(i.e. base station 1) received power fixed. The received power at another base station(i.e. base station 2) is varied. In this figure, the DTTV system performance is improved when compared with the previous technique.

The table -2 below shows the different SNR for different bit error rates at base station 1.

Table -2: Simulation results for base station 1

Technique	Bit Error Rate(b/s)	Signal to noise ratio(db)
Linear interpolation	0.0008	-12
OMP	0.0008	-12
MOMP	0.0002	-10

The below fig -5 shows the Bit Error Rate(BER) Vs Signal to Noise ratio, if one of the base station(i.e. base station 2) received power fixed. The received power at another base station (i.e. base station 1) is varied. In this figure, the DTTV system performance is improved when compared with the previous techniques.

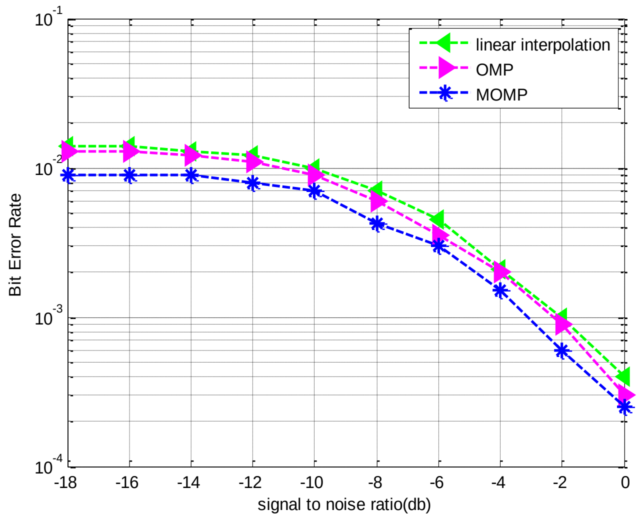

Fig -5: BER performance Vs signal to noise ratio at base station 2

The table -3 below shows the different SNR for different bit error rates at base station 2.

Table -3: Simulation results for base station 2

Technique	Bit Error Rate(b/s)	Signal to noise ratio(db)
Linear interpolation	0.012	-12
OMP	0.009	-10
MOMP	0.0042	-8

6. CONCLUSION

A modern broadcasting technology Digital terrestrial television (DTTV), which permitted users to offer television services with excellent image and sound quality. Many countries assigned with a new digital television(DTTV) standardization process. The modern digital broadcasting system to achieve additional BER and channel gains, the MIMO transmission scheme is utilized. An investigation of two base stations based SFN-STBC DTTV system, and provided the corresponding simulated performance under the 2- Rayleigh fading channel. In the DTTV system, the signal power variation of base stations results to different received powers in the receiver side. Thus, improved BER performance can be achieved through the MOMP technique.

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