A Study on DFT-Based Channel Estimation for ATSC 3.0 Systems

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***Abstract*— Discrete Fourier Transform (DFT)-based channel estimation is a widely used channel estimation scheme and can improve performance through noise reduction by forcing the channel impulse response outside the maximum delay spread to zero. Therefore, an appropriate window size must be set depending on the channel state to obtain the best performance in DFT-based channel estimation. In this paper, the DFT-based channel estimation performance is evaluated according to window size through simulation.**

I. Introduction

A subframe of the Advanced Television Systems Committee (ATSC) 3.0 system has several types of pilots, such as scattered, continual, edge, preamble, and subframe boundary pilots [1]. The receiver obtains the channel state information using the pilots. Linear interpolation is a simple scheme to estimate the channel gain from the received pilot signals. The discrete Fourier transform (DFT)-based channel estimation obtains the frequency response of the channel from the channel impulse response using the scattered pilots [2]. In the DFT-based channel estimation, the impulse response outside the maximum delay spread is forced to zero to remove unwanted impulse response and transformed into the frequency response of the channel using DFT. Therefore, it is necessary to set an appropriate window size depending on the channel state. In this paper, we study the effect of window size on the performance of the DFT-based channel estimation.

II. DFT-Based Channel Estimation

In ATSC 3.0, the scattered pilots are equally spaced in the frequency domain. The channel gains corresponding to the pilots can be obtained using the least square method. The channel gains, which are obtained from the scattered pilots, form a sampled frequency response. Using the inverse DFT, the sampled frequency response is transformed to channel impulse response in the time domain. Since the scattered pilots are equally spaced, the transformed channel impulse response has several repetition patterns. By removing the repeated parts, a single piece of the channel impulse response remains. Then, the unwanted impulse responses corresponding to the unwanted delay components of the channel are removed by forcing them to be set to zero. Finally, the filtered impulse response is transformed into the frequency response of the channel using DFT. Therefore, an appropriate window size must be set depending on the channel state to obtain the best performance in DFT-based channel estimation.

TABLE I. Simulation Parameter

Parameter	Value
Modulation Order	16-QAM
Pilot Pattern	SP4_2
Center Frequency	500 MHz
Channel Model	TU-6
FFT Size	8192

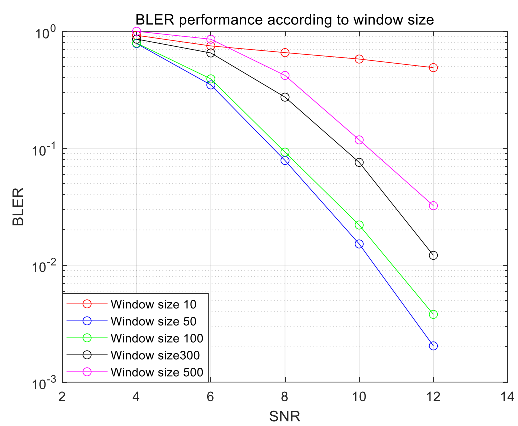

Figure 1. BLER performance of DFT-based channel estimation

III. Simulation Results and Conclusions

Figure 1 shows the block error rate performance of the DTF-based channel estimation according to the window size. In Table 1, the simulation parameters are provided. In this paper, we studied the effect of window size on the performance of the DFT-based channel estimation. Through the simulation results, we can know that the channel estimation performance can be improved by selecting an appropriate window size according to the channel condition.

References

[1] Advanced Television Systems Committee, *ATSC standard: A/321, System Discovery and Signaling*, Doc. A321, Mar. 2016.

[2] Dong Xiao-ping. DFT based channel and noise estimation algorithm analysis [J]. *Radio engineering*, 2012, 41(12): 12-14.

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