Low Complexity Channel Estimation based on Compressive Sensing for OFDM System

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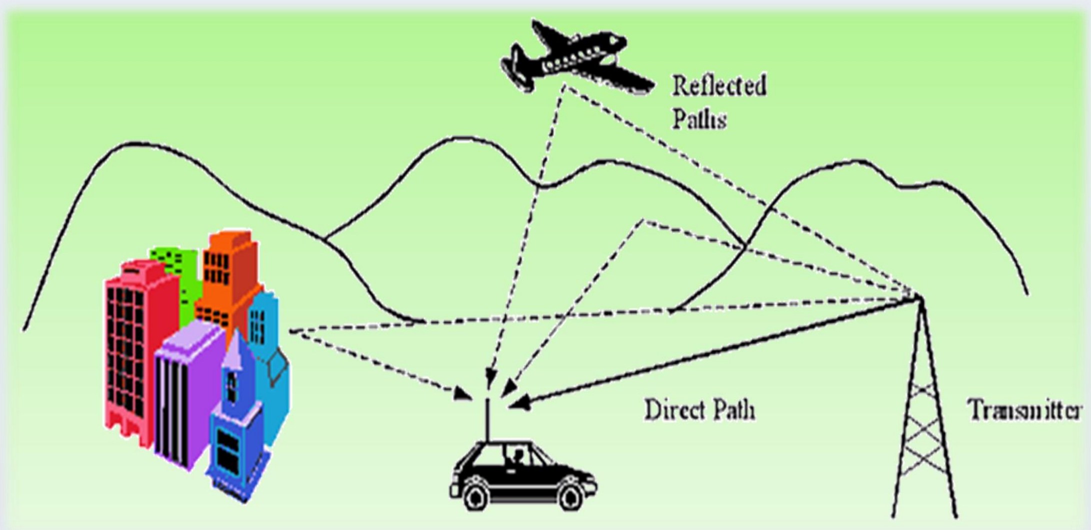
INTRODUCTION

In delay-Doppler double selective multi-path channel, the transmitted signal is reflected, diffracted and scattered from surrounding objects and arrives at the receiver as a superposition of multiple attenuated, delayed and frequency-shifted copies of the original signal.

The **compressive sending (CS)** based channel estimation provides accurate channel state information (CSI) and improves BER performance for OFDM systems. However, the high computational complexity due to the big size measurement matrix affects its implementation in high-rate communications. This paper proposes a low complexity scheme of CS-based channel estimation which use a 2-step method to estimate the CSI in time and frequency dimensions, sequentially. The proposed method can effectively reduce the measurement matrix size and lower the computational complexity.

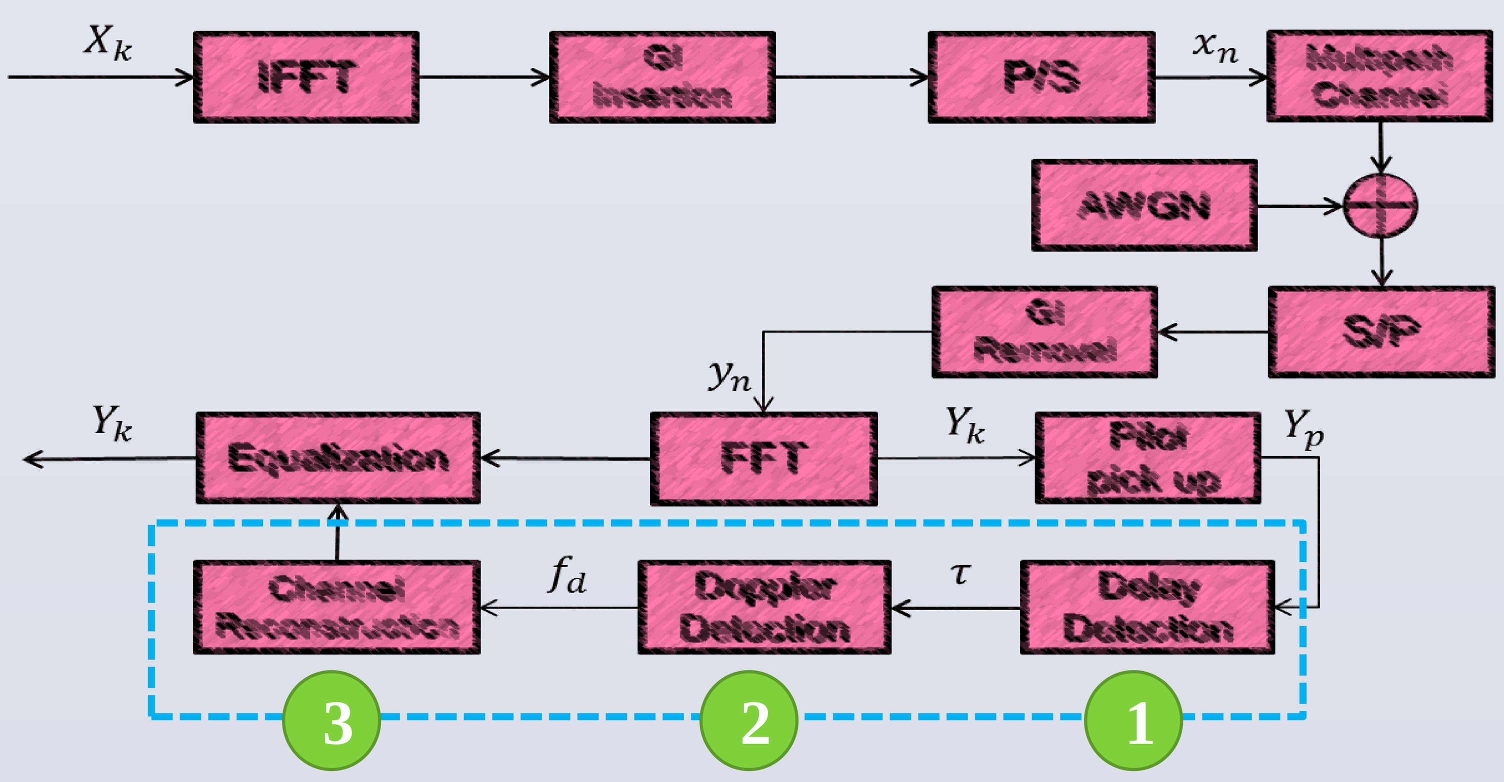
In multi-path channel
- *Reflection*
- *Diffraction*
- *Scattering*

Objectives of channel estimation
- *Accuracy*
- *Efficiency*



PROPOSED METHOD

- *2-step method based on CS theory for OFDM system*



3	2	1
Finally, the CSI is reconstructed with the combination of the estimated delay and Doppler information.	*Secondly, the results calculated by 1st step are used to detect the Doppler spread in each transmission path*	*Firstly, the received pilot signals are used to detect the delay spread and local the sparse path position*

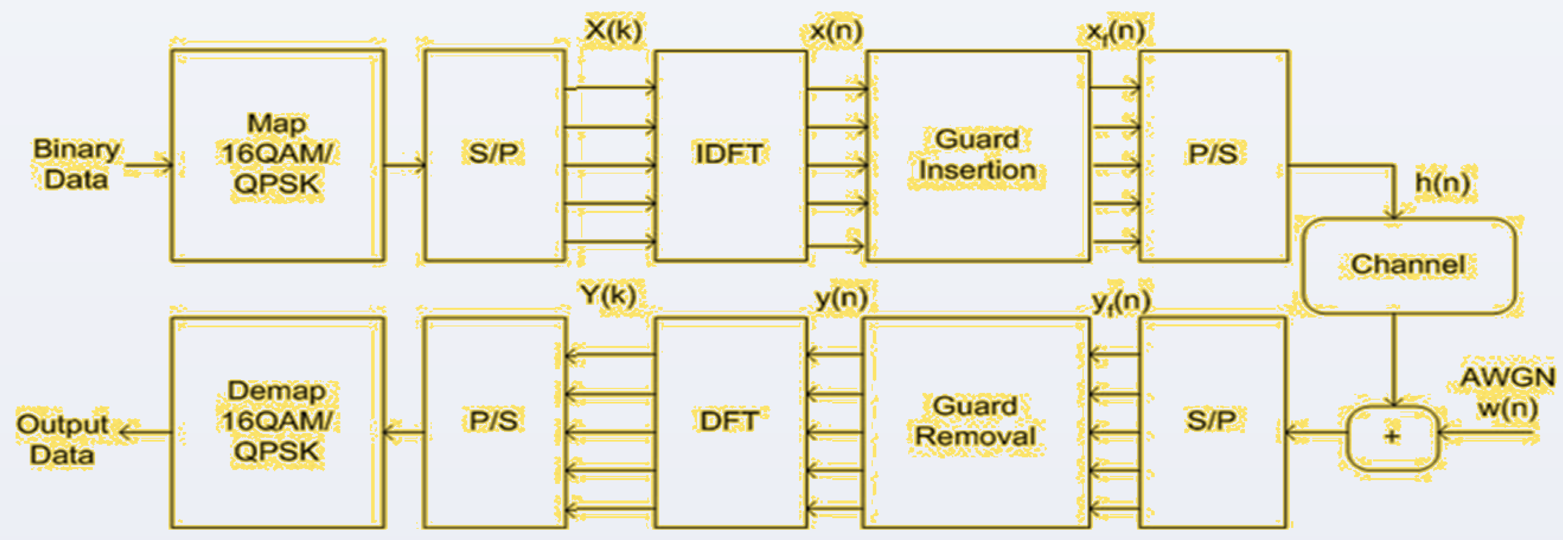
- *Lower computational complexity*
- *Accurate channel estimation performance*
- *Improving system efficiency*

CONCLUSIONS

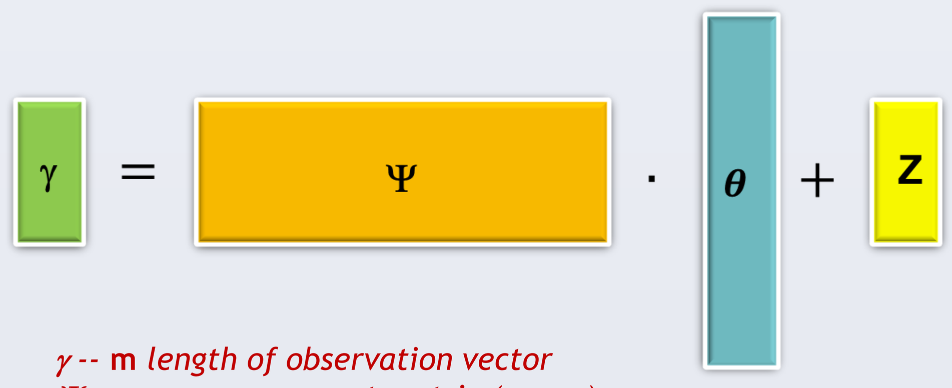
- The proposed 2-step method can successfully reconstruct the channel state information.
- The analysis results prove that the proposed method can reduce the computational complexity effectively.
- The proposed method using MMP gives better performance than using DS in terms of BER and computational cost.

SYSTEM MODEL

- *Basic OFDM system*



- *Compressive Sensing*



γ -- m length of observation vector
Ψ - m×n measurement matrix (m<<n)
*θ - n length of **p-sparse** reconstruction vector*
Z - m length of Additive White Gaussian Noise vector

- More accurate recovery
- Less sampling basis
- Sparse channel environment
- Appropriate non-correlative sampling basis
- Solution of linear program

SIMULATION

- *System Environment*

Simulation Parameter	
System model	Basic OFDM
Channel model	Double-selective multi-path channel
Modulation	16QAM
Bandwidth	20 MHz
Carriers	48
FFT windows	64
Sample times	32
GI length	16
Max delay spread	16
Max Doppler spread	4
Paths	3

- *Computational Complexity Analysis*

Simulation Time Cost Comparison (for 100 loops)	
Conventional CS Method	624.644 Sec
Proposed Method with DS	37.162 Sec
Proposed Method with MMP	0.872 Sec

- *The proposed method gives about 90% reduction of computational cost against conventional CS-based method.*

- *BER Performance comparison*

- *In proposed method, using Orthogonal Matching Pursuit (OMP) algorithm gives about 2 dB BER improvement against using Dantzig Selector (DS) algorithm.*