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Field of study: wireless communications, array signal processing, statistical signal processing, image/video compression

Key words: wireless communications, array signal processing, parameter estimation, beamforming

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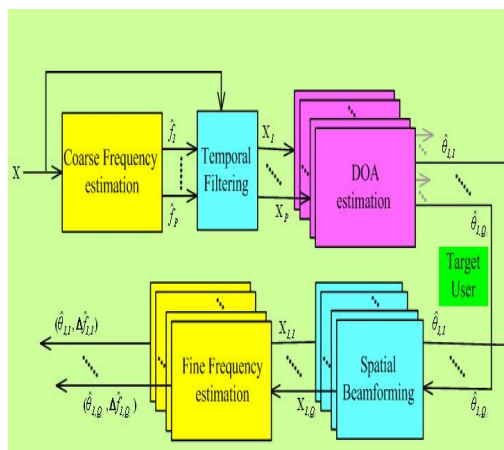
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### 一、 The Subject and Aims of Research

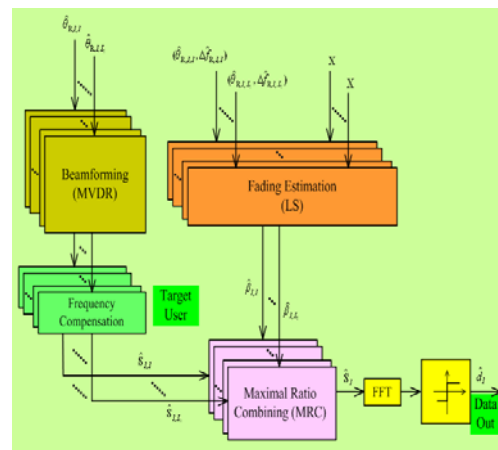
My research area focuses on applying advanced signal processing techniques to modern wireless communication systems, including the development of fast algorithms for joint channel parameter estimation, design of high performance beamformers and multi-user detectors for interference suppression in wireless communications, and the employment of some emerging technologies to enhance the performance.

### 二、 Related Recent Research Topics

- 1. Fast algorithms for joint channel parameter estimation:** Based on a novel twist of parameter estimation and filtering processes, we develop a high performance, yet low complexity algorithm for joint channel parameter estimation, which makes full use of the space-time characteristics of the signals to iteratively refine the parameter estimates in a space-time-space hierarchical structure based on the one-dimensional subspace algorithms. The new algorithm appropriately partitions the incoming signals into appropriate groups to enhance the estimation accuracy and the estimated parameters are also automatically paired due to the tree-structured estimation scheme. Furthermore, we also combine the estimated parameters, which carry out beamforming/filtering, along with the symbol detection scheme.



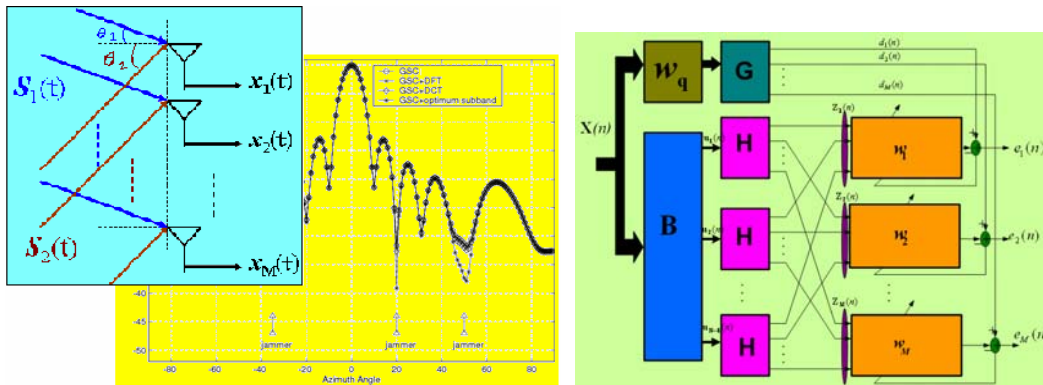
Joint DOA-Frequency Offset Estimation



Data Detection

- 2. Design of High Performance Beamformer:** We combine the generalized sidelobe canceller (GSC) with the optimum subband decomposition to render a high performance beamformer, referred to as the subcanceller, where the filter banks, succeeding the blocking matrix of the GSC is designed based on the minimum mean-square error (MMSE) criterion to produce the optimum interference decomposition. In addition, we also incorporate the decision

feedback technique into the subcanceller to further speed up the convergence rate and interference suppression capability.



Comparison of beampatterns

Block diagram of subband GSC

**3. Interference Suppression in Wireless Communications:** With the increase of users in wireless communications, we also explore the design of high performance multi-user detection (MUD). For this, we develop a hybrid MMSE MUD and serial interference canceller to reduce the overall complexity, while maintaining acceptable performance. Furthermore, to alleviate the multiple access interferences in overloaded system, we also propose some subspace-based approaches to design the optimum sequences.

**4. Emerging Technologies in Wireless Communications:** We explore some new technologies to enhance the performance and mitigate the computational overhead in wireless communications, which include: (1) Soft computation techniques such as genetic algorithm and quantum computing; (2) Cross-layer consideration; (3) Dynamic bit allocation.

### 三、 Selected Publications and Projects

#### 1. Publications :

- (1) J.-D. Lin, **W.-H. Fang**, Y.-Y. Wang, and J.-T. Chen, "FSF MUSIC for joint DOA-FOA estimation and its performance analysis," *IEEE Trans. Signal Proc.* Dec. 2006
- (2) Y. Chu and **W.-H. Fang**, "Performance analysis of a wavelet-based generalisedsidelobe canceller," *IEEE Trans. Antennas Propagation*, vol. 51, no. 3, pp. 519-534, Mar 2003.
- (3) Y.-Y. Wang, J.-T. Chen, and **W.-H. Fang**, A one-dimensional Tree-structure Based Algorithm for DOA-Delay joint Estimation, in Chapter 7 of *Advances in Direction of Arrival*, 2005.

**2. Projects :** Joint Frequency Offset-DOA Estimation and Symbol Detection in MIMO-OFDM System · NSC 2005