On the Baseband Algorithms for OFDM Systems

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Outlines

- OFDM systems
- Implementation impairments
- Baseband Algorithms
  - Windowing/pulse shaping
  - Time/Frequency synchronization
  - Channel estimation
  - CTC
  - MIMO

OFDM systems

- ADSL
- 802.11a/g/n
- ETSI DAB
- ETSI DVB-T
- IEEE802.16e/m/WiMAX
- ETSI DVB-H
- LTE, LTE-advanced

Implementation impairments

- Carrier frequency offset
  - Oscillator
  - Doppler drift
- Timing offset
- Sampling clock frequency offset
- Phase noise
- I-Q channel mismatch
- Nonlinear distortion
  - Peak-to-Average-Power-Ratio (PAPR)

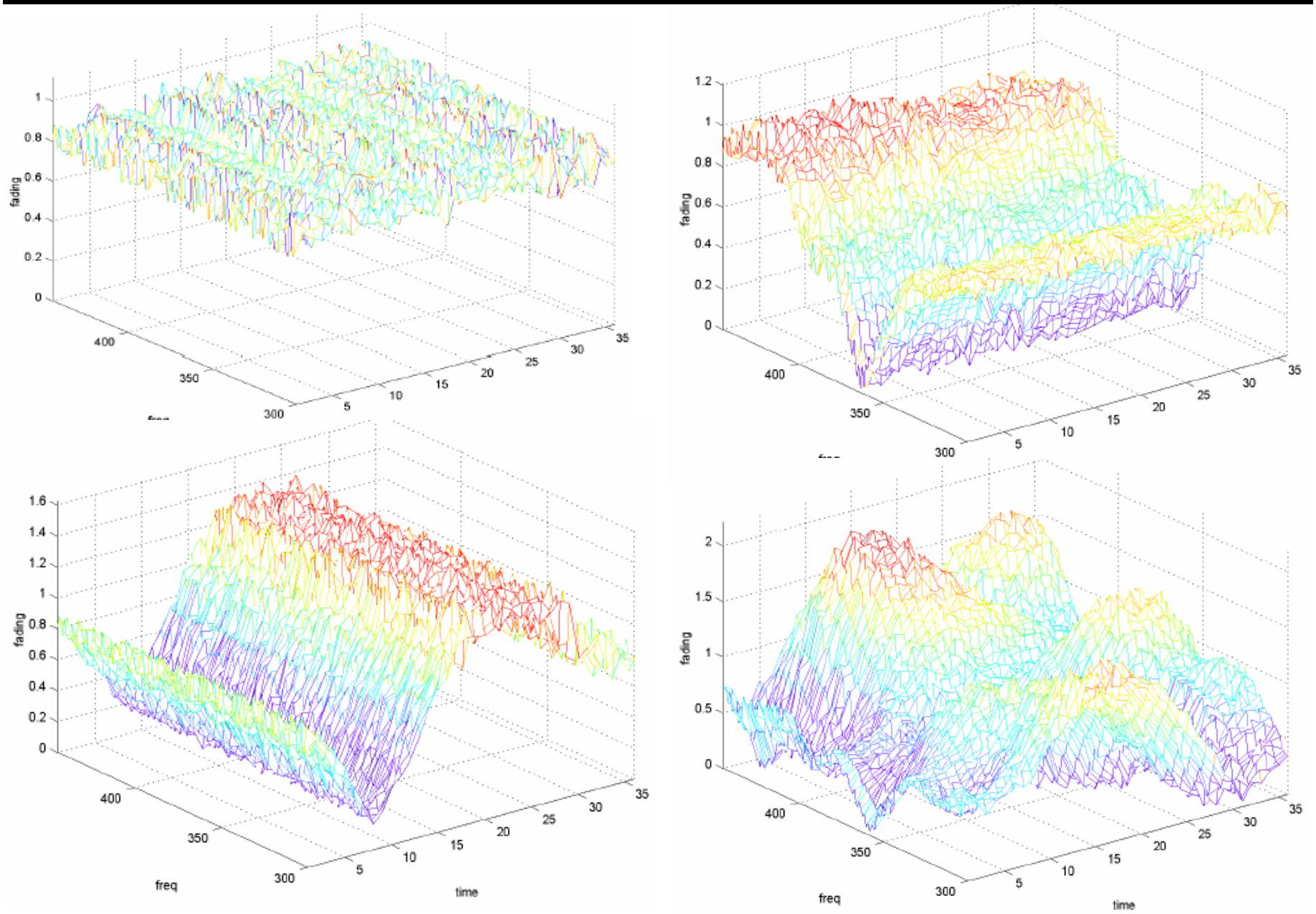
Baseband Algorithms : Windowing/pulse shapping

- **Bandwidth limiting**
  - **Out-of-band suppression**
- **Zero crossing at integer multiples of symbol time**
  - **Reduce intersymbol interference (ISI)**
- **Reduce Secondary lobes**
  - **Reduce intersymbol interference (ISI)**
  - **Reduce main lobe leak**
- **Maintain orthogonality condition**
  - **Basic OFDM principle**

Baseband Algorithms : Time/Frequency synchronization

- **Decision-directed/Data-aided synchronization**
  - **Pseudo-random preamble/pilot**
  - **Frame/Symbol timing and carrier frequency offset**
- **Two-stage synchronizer**
  - **Coarse estimation: acquisition stage**
  - **Fine estimation: tracking stage**

Baseband Algorithms : Channel estimation



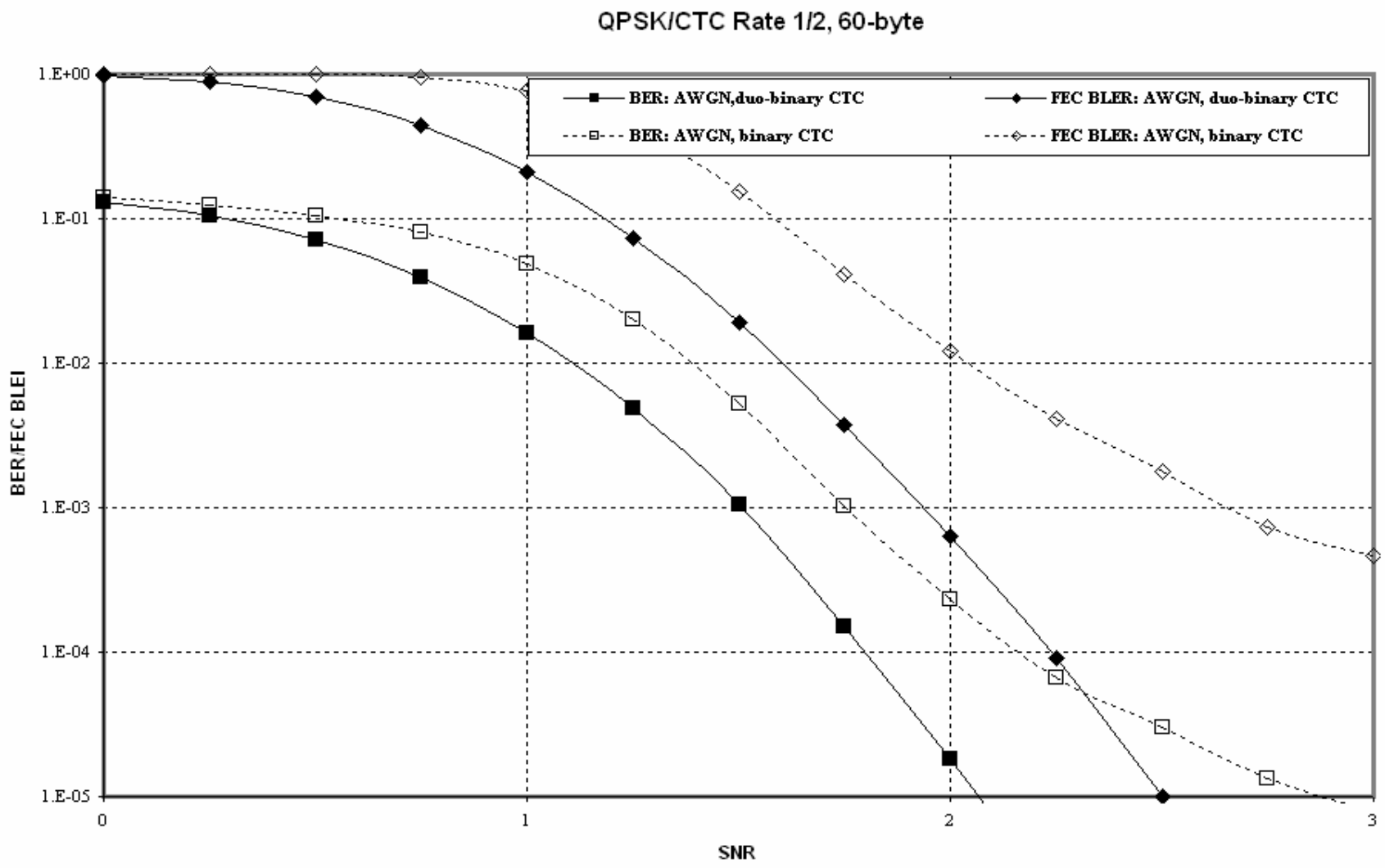
◆Pilot-assisted channel estimation

- ➢ 2-D interpolation filter
  - ✪Limited number of pilot in practice
  - ✪Edge effect
  - ✪Susceptibility to noise
- ➢ 2-D Wiener filter (MMSE)
  - ✪Limited number of pilot in practice
  - ✪Power delay profile & Doppler power spectrum
- ➢ 2 1-D filter

Baseband Algorithms : CTC

- **BCJR algorithm**
  - **Symbol-by-symbol MAP algorithm**
- **Map, Log-Map and Max Log-Map**
- **Binary vs Duo-binary**
- **Tail biting**
  - **Circular Recursive Systematic Convolutional code**

CTC, binary vs duo-binary



Baseband Algorithms : MIMO

- **Space Time Coding (STC)**
  - **Alamouti Coding**
- **Spatial Multiplexing (SM)**
  - **ML receiver**
  - **MMSE receiver with successive interference cancellation (SIC)**