A Fast Computation without Divisions for Combiners in Carrier Interferometry OFDM System

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Presentation Outline

- Orthogonal Frequency Division Multiplexing (OFDM)
- Peak-to-Average Power Ratio (PAPR) Problem
- Carrier Interferometry OFDM (CI/OFDM)
- Multipath Fading Effects
- Frequency Domain Equalization
- Proposed Combiners
  - Make Efficient of FFT Spreading at the receiver
  - Fast Computation with Improved Newton-Raphson
- Conclusions

OFDM and High Peak Problem

- OFDM: Technology for high-data rate applications and robust to against frequency selective fading effects.
- One disadvantage of OFDM is its high PAPR.
- Low PAPR → Safe Battery Power → Suitable for Ubiquitous Computing.

The Idea of Peaks Reduction

- IFToFT can do both of CI generating and CI spreading at the same time.

Proposed FFT Spreading

- FFT is very efficient for replacing the CI
- FFT can do both of CI generating and CI spreading at the same time

Complexity Reduction by CI-FFT

- Computational Complexities of Generating CI Codes and Spreading Process*
**Impulse Response**

- Inter-Symbol-interference
- Frequency Selective

**Frequency Domain Equalizations**

**Equalizers Characteristics**

\[ W(k)_{ZF} = \frac{1}{H(k)} \]

\[ W(k)_{MMSE} = \frac{H^*(k)}{|H(k)|^2 + \sigma^2} \]

**Objectives of the Research**

- Obtain fast and low complexity design of CI/OFDM
  - Replace the division operation in the computation of combiner weights.
  - Using the summation in FFT-spreading for performing Combiner.
- One division can replaced by 2 multiplications and 1 subtraction
- Simple combiners

**Newton-Raphson Method**

To obtain the desired value, Newton-Raphson need more than 15X iterations.
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Bit-Error-Rate Performance

Proposed Range Extension

Subcarriers Index

Bit-Error-Rate Performance

Conclusions

- PAPR of OFDM can be reduce by CI-FFT/POCI-FFT
  - Simple Combiners, low computational complexity
  - Suitable for future ubiquitous computing with low power transmission
- Improvement of Newton-Raphson Method
  - One division can be replaced by 2 multiplications and one subtraction.
  - Range extension can reduce the number of iterations significantly from 15x \( \Rightarrow \) 2x