

Department of Electrical Engineering, IIT Madras
EE5141 : Cellular and Wireless Communications Fundamentals
List of Topics for Mini-Project – April 2016

1. Interleaved FDMA and FDOSS – PAPR comparison with OFDMA and DFT-spread OFDMA

Ref: Presentation on GMC (pdf file) by instructor course URL.

2. Improving the performance of modified LS (m-LS) based channel estimation by using PDP knowledge and/or matrix regularization; study MSE improvement

Ref: Discuss with instructor and TAs

3. Improving the performance of FFT-based channel estimation by using PDP knowledge and/or windowing; study MSE improvement

Ref: Discuss with instructor and TAs

4. Filterbank Multicarrier (FBMC) block modulation study

Ref: B. Farhang-Boroujeny, "OFDM versus filter bank multicarrier," in IEEE Signal Processing Magazine, May 2011.

5. Generalized Frequency Division multiplexing (GFDM) study

Ref: (a) G. Fettweis, G. M. Krondorf and S. Bittner, "GFDM: Generalized frequency division multiplexing," in IEEE Vehicular Technology Conference (VTC Spring09), April 2009.

(b) N. Michailow, M. Matthe, I. S. Gaspar, A. Caldevilla, and L. Mendes, "Generalized frequency division multiplexing for 5th generation cellular networks," IEEE Trans. Commun., 2014

6. Universal Filtered Multicarrier (UFMC) study

Ref: V. Vakilian et al., "Universal Filtered Multicarrier Technique for Wireless Systems beyond LTE," IEEE Globecom-13, GA, Dec. 2013.

For topics 4 thro 6, and for other 5G waveform candidates, see the contribution #162119 to 3GPP-RAN1 in April 2016. You can also see G.Wunder et al, "5GNOW – Non-orthogonal Asynchronous waveforms for future mobile applications," pp.97-105, IEEE Communications Magazine, Feb.2014.

7. Blind / semi-blind / non-coherent OFDM receivers – study and compare with coherent receiver

Ref: See Hanzo's book on MC-CDMA and OFDM; also discuss with instructor.

8. Biased estimator for OFDMA; as an example, look at the James-Stein estimator in the paper below

Ref: Sheetal Kalyani, R. Lakshminarayanan, and K. Giridhar. "Biased estimators with adaptive shrinkage targets for orthogonal frequency division multiple access channel estimation." IET Communications 7.1 (2013): 13-22

9. Space-time Block Codes and Space-frequency Block codes for OFDM links (e.g., Alamouti code). Comparison

10. Turbo-coded OFDM (convolutional turbo code mapped to various OFDM/OFDMA subcarriers)

The next 3 topics are from Dr. Suman Kumar. The references are his research papers (contact him at suman@tenet.res.in if you want a copy).

11. PPP vs Hexagonal: Cellular networks are usually modeled by placing the base stations based on hexagonal tessellation. Recently, a new model has been proposed where base-stations are arranged according to homogeneous Poisson point process (PPP). The focus of this topic would be the comparison of both the models.

Ref: A Tractable Approach to Coverage and Rate in Cellular Networks.

12. Impact of correlated interferers on rate: Typically, in practical scenarios correlation exists among the interferers. The focus of this topic would be to analyse the impact of these correlation among interferers on rate.

Ref: Impact of Correlation between Interferers on Coverage Probability and rate in Cellular Systems

13. Optimal FFR: In FFR, the users are classified as cell-centre users and cell-edge users based on SINR threshold. FFR performance approaches frequency reuse 1 at low value of SINR threshold. Whereas, it approaches frequency reuse 1/3 at high value of SINR threshold. The focus of this topic would be to find the optimal choice of SINR threshold which maximize the FFR performance.

Ref: Coverage Probability and Achievable Rate Analysis of FFR-Aided Multi-User OFDM-Based MIMO and SIMO Systems

14. Any MIMO detection algorithm from the below review paper:

Ref: S. Yang and L. Hanzo, "Fifty years of MIMO detection: the Road to Large-scale MIMO," see paper uploaded in course URL.

15. Multi-carrier Direct Sequence CDMA (MC-DS-CDMA) – frequency domain channel equalization followed by spreading *Ref:* See Hanzo's book on MC-CDMA and OFDM; Kaiser's book

16. Fading channel simulation using other PSDs -- example: Laplacian PSD, Gaussian PSD, etc. Find out the references.