Filter Bank Modulations for In-Home Radio Technologies
Andrea M. Tonello, Nicola Moret, Salvatore D’Alessandro
University of Udine - Italy
tonello@uniud.it, nicola.moret@uniud.it, salvatore.dalessandro@uniud.it

Abstract
The University of Udine is contributing on radio technology advances looking at spectral efficient multicarrier architectures. In particular, we focus on MIMO multiplexer filter bank schemes, cross layer optimization, filter bank orthogonal design, hardware impairments analysis. The results obtained show that significant performance improvements are attainable over WLAN channels using FMT modulation.

Orthogonal FMT
- M Filter bank channels
- N Interpolation factor
- The IDFT output coefficients and DFT input coefficients must be identical to have perfect reconstruction (PR)
  \[ \sum_{n=0}^{M-1} \alpha_n \cdot e^{i \omega n} = 1 \quad \text{for all } \omega \]
- This leads to a matrix representation in the Z-Domain of the PR conditions
  \[ H_z c = I \]
- Submatrices \( G_z \) and \( H_z \) have coefficients equal to the polyphase components of the pulse with delays
- The FB has perfect reconstruction if every sub-block is the identity matrix
- Parameterize the pulse coefficients via trigonometric functions of angles
- Search for pulses that fulfill the orthogonal relations with the goal of maximizing the in-band energy

Adaptive FMT and OFDM over WLAN Channels
- For each channel realization, the optimal overhead factor (OH) namely \( \rho \), maximizes the achievable rate, i.e.,
  \[ \rho = \arg \max_{\rho} \{ C(\rho) \} \]
- To diminish the computational complexity we adapt the OH over a small set of values, i.e.,
  \[ \rho_{FMT} = \arg \max_{\rho} \{ C(\rho) \} \]

Efficient realization and Synchronization Algorithm for FMT systems
- Efficient Implementation parameters:
  \[ M \times L \text{, e.g. } (M, N) = (2, 1) \]
- Pulses: FF components of order \( N \cdot g^M(2^m - 1) \), for \( m = 0, \ldots, M - 1 \)
- Sample / Interpolation period \( L \)
- Synthesis / Analysis period \( L_0 \)
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- Prototype pulse length \( L_0 \)

Concentrated Scheme
- The users are multiplexed in a frequency division fashion. The transmitter of each user comprises three stages:
  - IS data spreading stage
  - Cyclically prefixed DMT modulator
  - Inner (with respect to the physical media) FMT modulation stage with transmission over \( N_f \) antennas

Ongoing project website: http://www.ict-omega.eu
Contact OMEGA: info@ict-omega.eu