Study and implementation of Widely Linear (WL) Receiver for Filter Bank based Multicarrier (FBMC-OQAM) modulations

Mots clés :
- Directeur de thèse : Pascal CHEVALIER
- Co-encadrant(s) :
- Unité de recherche : Centre d'Étude et de Recherche en Informatique et Communications
- École doctorale : École Doctorale Informatique, Télécommunications, Électronique de Paris
- Domaine scientifique principal : Divers

Résumé du projet de recherche (Langue 1)

DESCRIPTION : Filter Bank based Multicarrier (FBMC-OQAM) modulations are proposed waveforms for next generation 5G wireless systems. They offer better frequency localization compared to classical CP-OFDM. This property makes FBMC well suited for asynchronous communications (Ad Hoc or Cognitive radio applications) [1], [2], [3], [4]. In order to guarantee, after simple matched filtering processing, orthogonality between subcarriers at reception for SISO and SIMO links and for propagation channels with no delay spread, it is necessary to use an offset modulation for FBMC, known as Offset Quadrature Amplitude Modulation (OQAM) [5]. However, for MIMO links and/or highly frequency selective channels, the orthogonality between subcarriers after simple matched filtering operation is lost and Inter-Carrier Interference (ICI) and/or Inter-Symbol Interference (ISI) appear at reception. On the other hand, it appears that the OQAM constellation is a second order non-circular signal, also called quasi-rectilinear, as well as the MSK and GMSK modulations. That is to say that it can be processed as one-dimensional filtered modulation after dedicated pre-processing. The use of this property combined with Widely Linear filters [6] at the receiver should increase, for both MIMO links and highly frequency selective channels, the robustness of FBMC-OQAM waveforms to Inter-Symbol Interference (ISI), Inter-Carrier-Interference (ICI) and also co-channel interferences (CCI). In this context, the PhD objectives are: - To develop and to analyze the performance of SISO and SIMO Widely Linear receivers for FBMC-OQAM modulations for frequency selective channels. - To develop and to analyze the performance of MIMO links for both frequency selective and non frequency selective propagation channels for different transmission schemes implementing either spatial multiplexing (SVD, V-BLAST) or Spatio-Temporal Coding (Alamouti..). - To robustify the previous receivers to CCI. - To implement the proposed algorithms on a software defined radio platform (USRP boards and FPGA). REFERENCES : [1] EMPHATIC Project, Enhanced Multicarrier Techniques for Professional Ad-Hoc and Cell-Based Communications, http://www.ict-emphatic.eu/ [2] 5GNOW Project, 5th Generation Non-Orthogonal Waveforms for Asynchronous Signalling, http://cordis.europa.eu/projects/rcn/104990_en.html [3] 5GNOW: Challenging the LTE Design Paradigms of Orthogonality and Synchronicity Gerhard Wunder et al. VTC spring 2013 [4] On the Use of Filter Bank Based Multicarrier Modulation for Professional Mobile Radio Markku Renfors et al. VTC spring 2013 [5] M.Bellanger, “Filter banks and OFDM/OQAM for high throughput wireless LAN”, conf. ISCCSP’08, Malta, 12-14 March 2008 [6] Bernard Picinbono and Pascal Chevalier, Widely Linear Estimation with Complex Data, IEEE TRANSACTIONS ON SIGNAL PROCESSING, VOL. 43, NO. 8, AUGUST 1995

Résumé du projet de recherche (Langue 2)

The PhD objectives are: - To develop and to analyze the performance of SISO and SIMO Widely Linear receivers for FBMC-OQAM modulations for frequency selective channels. - To develop and to analyze the performance of MIMO links for both frequency selective and non frequency selective propagation channels for different transmission schemes implementing either spatial multiplexing (SVD, V-BLAST) or Spatio-Temporal Coding (Alamouti..). - To robustify the previous receivers to CCI. The thesis will be supervised by Pascal CHEVALIER and Hmaied SHAIEK in laboratory CEDRIC/CNAM.

Informations complémentaires (Langue 2)

CONTACTS : Pascal.chevalier@cnam.fr, 01 40 27 24 85 Hmaied.shaiek@cnam.fr, 01 40 27 24 99 http://cedric.cnam.fr/index.php/labo/laetitia