Título: Esquemas de codificación y detección eficientes para sistemas multiantenas 5G (**Joaquín Cortez**)

Problema a resolver: Space-time wireless communications codes aim to exploit the capacity of the multiple input-multiple output (MIMO) channel [1], in which both transmitter and receiver make use of multiple antennas. Some space-time codes spread the transmitted information over space and time, providing a diversity gain. This gain is due to the multiple versions of each transmitted symbol available to the receiver. Other codes offer spatial multiplexing gain; independent symbols. Are transmitted over different antennas at each channel use, increasing the data rate, but also the interference at the receiver. In this case, using a large number of receiver antennas helps to decrease the error rate, but increases the system's complexity. One example of spatial-multiplexing codes is the vertical Bell Labs layered space-time (V-BLAST) architecture [2]. Space-time orthogonal and quasi-orthogonal block codes (STBC), such as the Alamouti scheme [3], are examples of diversity codes. Linear dispersion codes (LDCs) were proposed in [4] with the objective of obtaining a measure of both multiplexing and diversity gain. LDCs can be designed to achieve an optimal trade-off between spatial multiplexing and diversity transmission. These codes may be decoded with an ordered, successive interference cancellation (OSIC) decoding algorithm first proposed for use with V-BLAST. An alternative approach, known as hybrid coding (HC) [5-12], consists of the selection of some of the available transmit antennas to work in STBC mode, while the remaining ones operate as V-BLAST. Their principal disadvantage is high receiver complexity. In particular, the double space-time transmit diversity (DSTTD) scheme [12] is an interesting example of hybrid coding; it is organized in layers, just like V-BLAST, but each layer is actually an Alamouti encoder; this increases spectral efficiency over pure STBC, and its structure allows the design of simple detectors. In [7] a very low complexity detector based on the sorted QR decomposition, implemented using the CORDIC algorithm, for both DSTTD and hybrid STBC-VBLAST schemes was proposed. However, all of these suffer from significant performance degradation in comparison with the maximum-likelihood (ML) detector. The ML detector can attain optimal performance, but its complexity grows exponentially with the number of antennas and constellation size. The sphere decoder [13] offers ML error performance with reduced complexity. The size of the search for the closest point is reduced by efficiently finding candidates inside a hypersphere centered around the received symbol. This leads to polynomial complexity in the high signal-to-noise ratio (SNR) region. In [11], an efficient ML detector for DSTTD was proposed, which combines simplified QR decomposition-based decision-feedback (DF) detection and a method that reduces the size of the search for valid candidates. Although it can maintain the exact ML error performance, its worst-case and average complexity is significantly lower than that of Schnorr-Euchner sphere decoding (SE-SD). In this work, we pretend to design a variant the ML algorithm proposed in [11]; the goal of the proposed decoder is to reduce the computational complexity significantly without a reduction in bit error rate (BER) performance.

Productos académicos comprometidos: Un paper para congreso. Someter un artículo a revista indizada en JCR.

Estancia del estudiante: Estancia de un mes en alguno de los siguientes lugares: ITESO, CINVESTAV-GDL o Universidad del Caribe con el objetivo de desarrollos e implementaciones de los algoritmos diseñados.

Conferencia del estudiante: IEEE: CCE 2018, LATINCOM 2017 o CONIELEOMP 2018.

Referencias: 1. I. E. Telatar. (1999) Capacity of multiple-antenna Gaussian channels. European Transactions on Telecommunications, Vol. 10, No. 6, p. 585-595.

2. G. J. Foschini. (1996) Layered space-time architecture for wireless communication in a fading environment when using multi-element antennas. Bell Labs Tech. J., Vol. 1, No. 2, p. 41-59.

3. S. M. Alamouti. (1998) Layered space-time architecture for wireless communication in a fading environment when using multi-element antennas. IEEE Journal on Selected Areas in Communications, Vol. 16, No. 8, p. 1451-1458.

4. B. Hassibi and B. M. Hochwald. (2002) High-rate codes that are linear in space and time. IEEE Transactions on Information Theory, Vol. 48, No. 7, p. 1804-1824.

5. Seung-Jun Yu, Eui-Young Lee and Hyoung-Kyu Song. (2015) Combination of STBC and SM Scheme with Iterative Detection in LTE Systems. Wireless Personal Communications, Vol. 83, No. 2, p. 1203-1211.

6. F. R. C. Soria, J. S. Garcia, and F. M. M. Barboza. (2015) Improved Detection of SMS Mux Signals for MIMO Channels. IEEE Latin America Transactions, Vol. 13, No. 1, p. 43-47.

7. M. Bazdresch, J. Cortez, O. Longoria and R. Parra Michel. (2012) A Family of Hibrid Space-Time Codes for MIMO Wireless Communications. Journal of Applied Research and Technology, Vol. 19, No. 2, p. 122-142.

8. J. Cortez et al. (2007) An efficient detector for non-orthogonal Space-Time Block Codes with Receiver Antenna Selection. IEEE Int. Symp. on Personal, Indoor and Mobile Radio Communications (PIMRC).

9. H. Kim, H. Park. (2005) Efficient successive interference cancellation algorithms for the DSTTD system. IEEE Int. Symp. on Personal, Indoor and Mobile Radio Communications (PIMRC).

10. H. Kim, H. Park. (2007) New DSTTD transceiver architecture for low-complexity maximum-likelihood detection. IEEE Wireless Communications and Networking Conference (WCNC).

11. Y.L.C. de Jong and T.J. Willink. (2002) Iterative tree search detection for MIMO wireless systems. IEEE Vehicular Technology Conference Fall.

12. J. Yue et al. (2003) Channel estimation and data detection for MIMO-OFDM systems. IEEE GLOBECOM Conference.

13. D. Wubben et al. (2001) Efficient algorithm for decoding layered space-time codes. Elec. Let., Vol. 37 (22), p. 1348.

14. K. Wu et al. (2009) Novel QRM-MLD Algorithm for V-BLAST Systems with Permuted Channel Matrix. IEEE 20th International Symposium on Personal, Indoor and Mobile Radio Communications.