Ordered Statistics Decoding for semi-Orthogonal Linear Block Codes over Random non-Gaussian Channels

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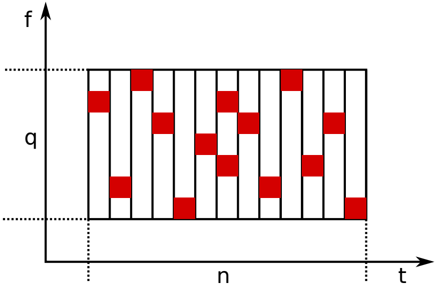
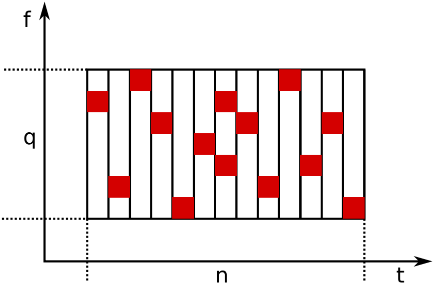
Outline

- OFDMA system model
- Inner code
- Order statistics decoding
- Conclusions

OFDMA system model

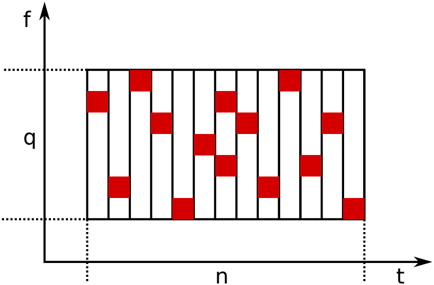


OFDMA system model



$$\mathbf{X} = \{x_{i,j}\}_{q \times n}$$
$$x_{i,j} = \|s_{i,j} h_{i,j} + \xi_{i,j}\|^2$$

OFDMA system model



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Ref:

Zyablov, V. and Osipov, D 'On the optimum choice of a threshold in a frequency hopping OFDMA system', Problems of Information Transmission, pp. 91-98, 2008.

Inner code

Inner code is a concatenation of

- Reed-Solomon $(q+1, 2, q)$-code
- Repetition $(\ell, 1, \ell)$-code

with resulting parameters: $n = (q+1)\ell,\ k = 2,\ d = q\ell.$

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For given parameters, each couple of codewords has exactly ℓ common points.

Masks

Codewords mappings

Each user block is filled with a codeword message by using q-ary multitone frequency modulation.

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Definition

Binary $q \times n$ matrix M_i with each column weight being exactly 1 is a mask matrix if it corresponds to a codeword c_i of $(n, k)_q$-code.

Order statistics

Definition

Given a matrix of measurements $\mathbf{X}$, corresponding rank matrix $\mathbf{R} = \{r_{i,j}\}_{q \times n}$ is defined by assigning to each energy measurement a number of measurements it exceeds:
$r_{i,j} = \#\{x_{l,m} < x_{i,j}\},\ x_{l,m},\ x_{i,j} \in \mathbf{X}$

Definition

Application of mask matrix to measurements matix $\mathrm{f}\left(\mathbf{M}_i, \mathbf{X}\right)$ is an element-wise multiplication of matrices $\mathbf{M}_i$ and $\mathbf{X}$.

Rank decoder

Rank decoder operates on the order statistics of the measurements matrix $\mathbf{X}$. It applies different mask matrices to corresponding rank matrix $\mathbf{R}$ and selects one with the highest rank sum.

$$D_{RANK} = \underset{k=1..q^2}{\operatorname{argmax}} \operatorname{sum} \operatorname{f}\left(\mathbf{R}, \mathbf{M}_k\right).$$

Order Statistics Normalized Envelope Detection Based Diversity Combining Decoder

Ref:

S. Ahmed, L-L. Yang, L. Hanzo ‘Diversity Combining for Fast Frequency Hopping Multiple Access Systems Subjected to Nakagami-m Fading’, IEE 3G and Beyond, pp. 235–239, 2005

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OSN decoder operates on order statistics of separate measurements corresponding to different masks.

$x_k = f(\mathbf{M}_k, \mathbf{X})$

$x'_{k1} \leq x'_{k2} \leq \cdots \leq x'_{kn}.$

$$D_{OSN} = \underset{k=1..q^2}{\operatorname{argmax}} \sum_{t=1}^{n} \frac{x'_{kt}}{\chi_t},$$

where $\chi_t = \sum_{i=1}^{q^2} x'_{it}.$

Simulation results

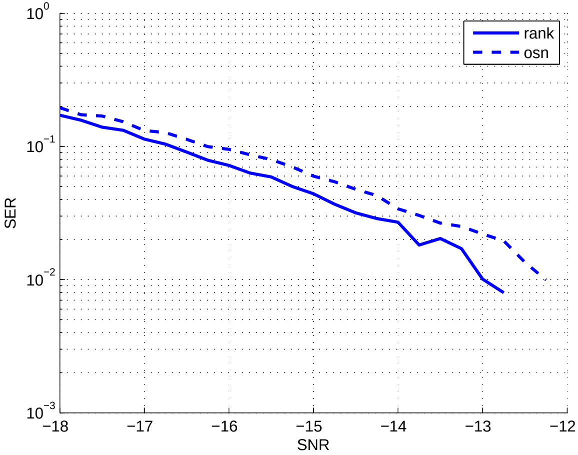

Рис.: Collisions in 15% of user area with interference power 20db

Simulation results

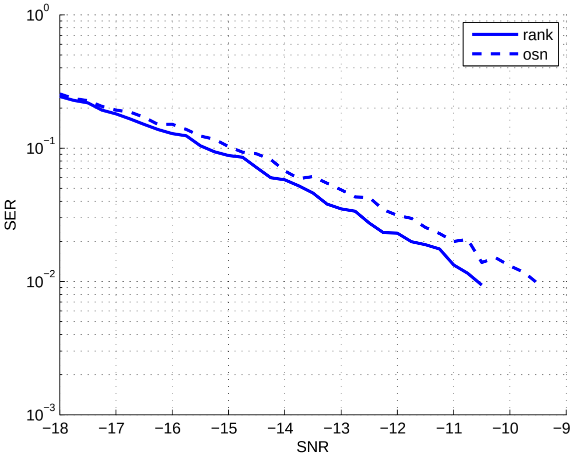

Рис.: Collisions in 25% of user area with interference power 20db

Simulation results

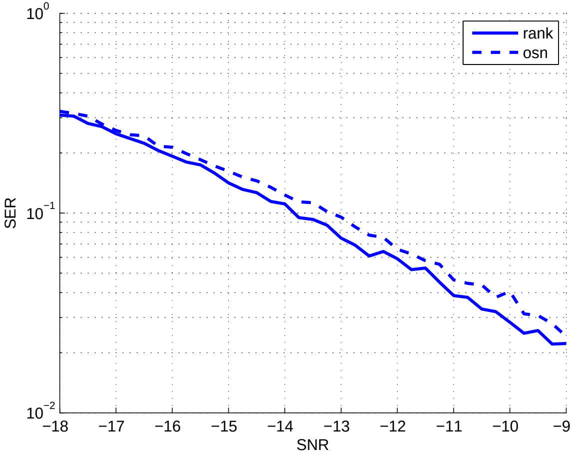

Рис.: Collisions in 30% of user area with interference power 20db

Simulation results

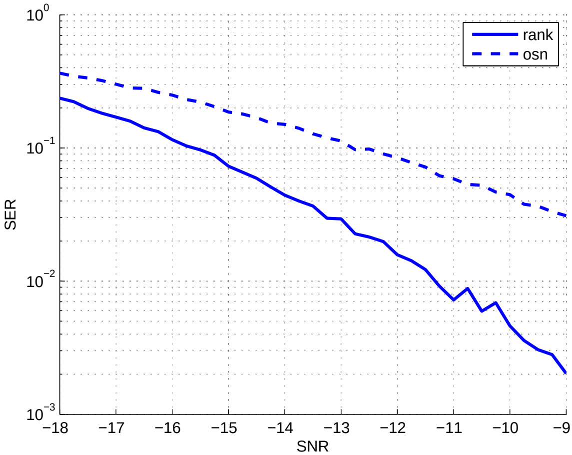

Рис.: Collisions in 15% of user area with interference power 30db

Simulation results

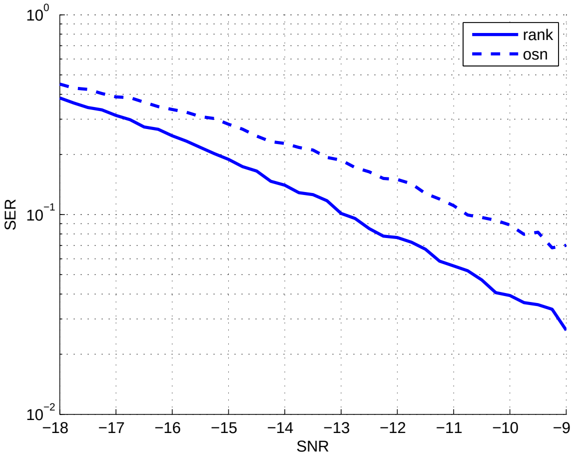

Рис.: Collisions in 25% of user area with interference power 30db

Thank you for your attention!