

CLAIMS

1. Method for receiving and carrying out anti-jamming equalization on a signal in a multi-reception-channel receiver, said signal comprising at least one learning sequence (101) formed from known symbols and at least one sequence (102) of useful data, which sequence is formed from unknown symbols, the method being characterized in that it comprises steps of:
- receiving said signal in a plurality of reception channels of the receiver, and transposing and discretizing (401, 111, 121, 112, 122) the multi-reception-channel signal into a discretized baseband equivalent multi-reception-channel signal;
 - synchronizing (402, 140) the discretized baseband multi-reception-channel signal;
 - calculating (403, 150) an impulse response in the frequency domain of the multi-reception-channel propagation channel $\hat{\mathbf{h}}(f)$ and a correlation matrix $\hat{\mathbf{R}}$ of the noise and interference, from at least one portion corresponding to a learning sequence of said synchronized multi-reception-channel signal; the calculation of the impulse response in the frequency domain of the multi-reception-channel propagation channel $\hat{\mathbf{h}}(f)$ comprising:
 - calculating a matrix $\hat{\mathbf{R}}_{DX}$ expressing the intercorrelation between a learning sequence and a portion corresponding to said learning sequence of the synchronized multi-reception-channel signal;
 - calculating an autocorrelation matrix $\hat{\mathbf{R}}_{XX}$ of said portion corresponding to a learning sequence of said synchronized multi-reception-channel signal;
 - calculating a multi-sensor propagation-channel matrix $\hat{\mathbf{H}}$ from the matrix $\hat{\mathbf{R}}_{DX}$ and from an autocorrelation matrix $\mathbf{R}_{DD}$ of said learning sequence, with $\hat{\mathbf{H}} = \hat{\mathbf{R}}_{DX}^H \mathbf{R}_{DD}^{-1}$, where ^{H} is the conjugate-transpose operator, and
 - calculating the impulse response in the frequency domain of the multi-reception-channel propagation channel $\hat{\mathbf{h}}(f)$ for each reception channel of the receiver, by Fourier transformation of the vectors $\hat{\mathbf{h}}_k(n)$ forming the columns of the matrix $\hat{\mathbf{H}}$;

- transposing (404, 231) to the frequency domain at least one portion corresponding to a sequence of useful data of the synchronized multi-reception-channel signal, and filtering (405, 232) with the vector $\mathbf{w}(f)$, where

$$\mathbf{w}(f) = \frac{\hat{\mathbf{R}}^{-1} \hat{\mathbf{h}}(f)}{1 + \hat{\mathbf{h}}(f)^H \hat{\mathbf{R}}^{-1} \hat{\mathbf{h}}(f)},$$

the signal resulting from said filtering being a single-reception-channel signal in the frequency domain; and

- transposing (406, 233) said single-reception-channel signal to the temporal domain.

2. Receiving and equalizing method according to Claim 1, wherein the correlation matrix $\hat{\mathbf{R}}$ of the noise and interference is obtained using the formula:

$$\hat{\mathbf{R}} = \hat{\mathbf{R}}_{XX} - \hat{\mathbf{H}} \hat{\mathbf{R}}_{DX}.$$

3. Method for receiving and carrying out anti-jamming equalization according to one of Claims 1 and 2, wherein said matrices $\mathbf{R}_{DD}$, $\hat{\mathbf{R}}_{DX}$ and $\hat{\mathbf{R}}_{XX}$ are calculated using the following formulae:

$$\begin{aligned} \mathbf{R}_{DD} &= \frac{1}{P-L+1} \sum_{n=L-1}^{P-1} \mathbf{d}(n) \mathbf{d}(n)^H, \\ \hat{\mathbf{R}}_{DX} &= \frac{1}{P-L+1} \sum_{n=L-1}^{P-1} \mathbf{d}(n) \mathbf{x}(n)^H, \\ \hat{\mathbf{R}}_{XX} &= \frac{1}{P-L+1} \sum_{n=L-1}^{P-1} \mathbf{x}(n) \mathbf{x}(n)^H, \end{aligned}$$

where

- $\mathbf{d}(n)$ is a vector formed from the symbols of a learning sequence;
- $\mathbf{x}(n)$ is a vector formed from the symbols received in a portion corresponding to the learning sequence $\mathbf{d}(n)$ of said synchronized multi-reception-channel signal;
- P is the number of symbols in said learning sequence $\mathbf{d}(n)$; and
- L is a length of an equalization window.

4. Multi-reception-channel receiver (110) allowing reception and anti-jamming equalization of a signal comprising at least one learning sequence (101) formed from known symbols and at least one sequence (102) of useful data, which sequence is formed from unknown symbols, said receiver being
 5 configured to receive the signal in each of its reception channels, and to transpose and discretize the multi-reception-channel signal into a discretized baseband equivalent multi-reception-channel signal (401) and being characterized in that it comprises at least one piece of equipment (130) for processing the signal, which is configured to implement a method for receiving
 10 and carrying out anti-jamming equalization by executing steps of:
- synchronizing (402) the discretized baseband multi-reception-channel signal;
 - calculating (403) an impulse response in the frequency domain of the multi-reception-channel propagation channel $\hat{h}(f)$ and a correlation matrix $\hat{R}$ of the noise and interference, from at least one portion
 15 corresponding to a learning sequence of said synchronized multi-reception-channel signal; the calculation of the impulse response in the frequency domain of the multi-reception-channel propagation channel $\hat{h}(f)$ comprising:
 - calculating a matrix $\hat{R}_{DX}$ expressing the intercorrelation between a learning sequence and a portion corresponding to said learning sequence of the synchronized multi-reception-channel signal;
 - calculating an autocorrelation matrix $\hat{R}_{XX}$ of said portion
 25 corresponding to a learning sequence of said synchronized multi-reception-channel signal;
 - calculating a multi-sensor propagation-channel matrix $\hat{H}$ from the matrix $\hat{R}_{DX}$ and from an autocorrelation matrix R_{DD} of said learning sequence, with $\hat{H} = \hat{R}_{DX}^H R_{DD}^{-1}$, where ^{H} is the conjugate-transpose operator, and
 - calculating the impulse response in the frequency domain of the
 30 multi-reception-channel propagation channel $\hat{h}(f)$ for each reception channel of the receiver, by Fourier transformation of the vectors $\hat{h}_k(n)$ forming the columns of the matrix $\hat{H}$;

- transposing (404) to the frequency domain at least one portion corresponding to a sequence of useful data or of the synchronized multi-reception-channel signal, and filtering (405) with the vector $\mathbf{w}(f)$, where

$$\mathbf{w}(f) = \frac{\hat{\mathbf{R}}^{-1}\hat{\mathbf{h}}(f)}{1 + \hat{\mathbf{h}}(f)^H \hat{\mathbf{R}}^{-1} \hat{\mathbf{h}}(f)}$$

- 5 the signal resulting from said filtering being a single-reception-channel signal in the frequency domain; and
- transposing (406) said single-reception-channel signal to the time domain.