ABSTRACT

Study of Blind Multiuser CDMA Receiver using Neural Network

This thesis presents an investigation into the various techniques of blind reception of Code Division Multiple Access (CDMA) signals. Blind detection is a process of channel or signal estimation without access to the original input. The conventional methods are non-blind; make use of a training sequence to estimate the unknown wireless channel so that estimated channel values are available for the rest of input. The estimated channel can then be used to detect the unknown user sequence. If the channel is time-varying, then some known (training or pilot) sequences must be inserted into the user's data periodically. In blind detection, on the other hand, the channel or signal is estimated based on prior knowledge of the temporal or spatial signal or channel properties, either statistically or deterministically, without access to either the actual input or the channel values. This makes the problem intrinsically more difficult than the "non-blind" or "informed" one. However, advantages such as bandwidth conservation and collision avoidance or collision reduction in multi-point communication render them highly useful in modern communication systems, whereas non-blind techniques fail miserably because of the unavailability of reliable training sequences in cases of severe interference or channel distortion. Also the blind method is applicable directly to many existing systems without any or major change to the present air interface or protocol.

In this thesis, a new methodology is devised, where the cumbersome channel estimation is avoided for the reception of CDMA signals. A two step adaptive process is suggested for the blind reception of linear multiple-input multiple-output channels suitable for the space time scenario. The receiver has the knowledge of only the spreading code of interest. The first step, using a higher order statistical approach, separates the user signals without explicit channel estimation. This is followed by the adaptive detection based on the principle of minimum output energy. The proposed
technique is found to be well suited to the problem of blind multiuser reception since no previous knowledge about the signal or propagation channel characteristics is required. The proposed implementation in part is by means of artificial neural network. This is illustrated using the simple case of a feed forward network which brings out clearly its advantages over conventional hardware counterparts.

The major contributions of this work are given below:

- Studied and analyzed the various detection techniques used for the conventional receivers.
- Studied the requirements of non-blind detection techniques.
- Studied the scope and requirements for a blind detection method.
- Studied the various statistical signal processing methods.
- A new hybrid method for the blind detection is devised which increases the channel bandwidth utilization at the same time giving satisfactory performance.
- Implemented the proposed method using artificial neural network.
- Algorithms are devised for the evaluation of the proposed scheme.
- The bit error performance of the proposed scheme is evaluated with different types of spreading codes in AWGN, Rayleigh and Rician channels.
- Evaluated the convergence of the algorithms.

This study and implementation of the blind reception technique is unique in its kind and similar work has not been cited so far. It is found that this blind detection scheme has better bit error performance than the non-blind techniques and offers better near-far resistance without the costly high precision power control. The fact that its implementation is also simple by means of soft computing techniques adds to its robustness and precision rendering it for further study and use.