Abstract

Multichannel Autoregressive (M-AR) parametric model has been recently used to model multichannel processes arise in many applications such as in sonar, radar, speech processing, biomedical engineering and wireless communications.

In the framework of wireless communications, each carrier in multicarrier systems (e.g., Orthogonal Frequency Division Multiplexing (OFDM)) is usually affected by time-varying fading. The fading processes over all carriers are often correlated and corrupted by Additive White Gaussian Noise (AWGN). In this application, the fading processes are usually modeled by M-AR model which can be combined with optimal filters such as Kalman or H_∞ filter for processes estimation from noisy observations. This requires the estimation of M-AR model parameters which is the key issue to be addressed in this thesis.

Several M-AR parameter estimation methods have been proposed in the litrature and can be classified as either off-line or on-line estimation techniques.

The off-line methods can be used when all observations are available for the estimation process. Off-line techniques such as Noise-Compensated Yule-Walker (NCYW) equations, Yule-Walker equations combined with Newton-Raphson, Improved Least Square for Vector (ILSV) processes and Errors-In-Variables (EIV) based method are all of interest. However, their computational costs are very high or some of them may diverge. In addition, these techniques are not suitable for on-line applications.

Using on-line techniques such as Kalman filter applied directly to the noisy observations results in biased parameter estimates. To avoid this problem, joint estimation of the process and its parameters based on Extended Kalman Filter (EKF) and Sigma Point Kalman Filter (SPKF) can be addressed. However, the size of the state vector to be estimated is quite high. To reduce the size and the resulting computational costs, we propose to use two cross-coupled optimal filters. Thus, we propose to extend to the multichannel case the so-called two cross-coupled Kalman or H_∞ filters initially introduced for the single channel case. We carry out a comparative simulation study between our methods and several other methods. This study is based either on synthetic M-AR process or M-AR process corresponds to fading channels. The results we obtained showed that our approach corresponds to a compromise between the computational cost and the performance in terms of parameter estimation accuracy.