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Abstract

The identification of nonlinear and chaotic systems is an important and challenging problem. Neural network models, particularly Recurrent Neural Networks (RNN) trained with suitable algorithms, have received particular attention in the area of nonlinear identification due to their potentialities to approximate any nonlinear behavior. A method of nonlinear identification based on the RNN model trained with improved nonlinear Kalman filter is proposed in this paper. The neural network weights are estimated using the Extended Kalman Filter(EKF) algorithm, augmented by the Expectation Maximization(EM) algorithm is used to derive the initial states and covariance of the Kalman filter. It was shown that not only could this chaotic approach provide an accurate identification, but it was also more effective in the sense that the approach had a smaller mean squares error (MSE). An experimental case study using the famous Venice lagoon time series is analyzed by the proposed algorithm. The minimum embedding dimension of the time series is calculated using the method of false nearest neighbors. The Lyapunov exponents of the model are calculated, from the state space evolution, The numerical results presented here indicate that the traditional Extended Kalman Filter algorithm combined with EM techniques are effective in building a good NN model for nonlinear identification.

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