Optimal Base Frequency Estimation of Electrical Signal Based on Prony's Estimator and FIR Filter

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Abstract

During the development of a frequency domain model of nonlinear electrical network, it is usually necessary to determine the frequency spectrum of the currents flowing thru the nonlinear devices [1, 2, 3]. There are many available methods dedicated to solve this problem [3, 5, 6]. In work [3] a spectrum estimation method has been proposed, which has better accuracy in comparison with other competitive methods like WIFTA or TDQS, while maintaining a low demand for computing power. The accuracy of this method depends on two main factors: accuracy of the base frequency estimation and accuracy of the signal interpolation in the resampling process. For the estimation of the base frequency, the method uses a first order Prony's estimator [5] and a bandpass FIR filter. In this paper, an attempt was made to find the optimal parameters for both: the Prony's estimator and the FIR filter. First, an analysis of the measurement window width of the Prony's estimator and the number of the FIR filter coefficients was performed. Then, the optimization problem was defined and the optimization of the mentioned parameters was performed (including the values of the FIR filter coefficients). Formulation of the optimization problem is not trivial, since the Prony's estimator is highly nonlinear and some of the optimized parameters (the window width and the number of filter coefficients) are discrete quantities. The research allowed to determine the optimal values of the considered parameters of the examined frequency estimation method. Along with the results presented in [4] it is now possible to implement the spectrum estimation method from [3] using the optimal set of parameters.

References

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