

Collaborative adaptive filtering approach for the identification of complex-valued improper signals

ABSTRACT

This paper proposes a novel hybrid filter for data-adaptive optimal identification and modeling of complex-valued real-world signals based on the convex combination approach. It is equipped with different complex domain characteristics of subfilter algorithm. The proposed hybrid filter takes advantage of the complex nonlinear gradient descent (CNGD) algorithm that exhibits fast convergence and the steady state of the augmented complex nonlinear gradient descent (ACNGD) algorithm. The output of CNGD and ACNGD was combined to work in parallel, feeding each individual subfilter output into a mixing algorithm, which in the end produced a single hybrid filter output. The mixing parameter $\lambda(k)$ within the hybrid filter architecture was made gradient adaptive in order to preserve the nature of inherent characteristics of the subfilters and to show its optimal performance in identifying and tracking second-order properness (circular) and improperness (noncircular) of the complex signals in real time. Further analysis was made on the properties of the algorithms, and the relationship between fast convergence and steady-state error was discussed. This analysis is supported by the complex-valued synthetic simulation and real-world application dataset as applied in renewable energy (wind).

Keyword: Widely nonlinear modeling; Augmented complex statistics; Augmented (CNGD); Nonlinear systems; Collaborative filters; Wind modeling