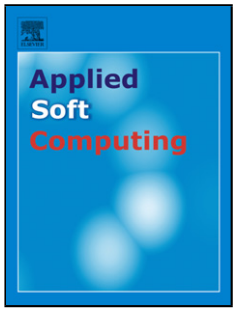

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A novel bilinear functional link neural network filter for nonlinear active noise control

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Highlights

- A novel bilinear FLNN (BFLNN) filter combining the trigonometric function expansion, feedback output signals and the products of input signals and feedback output signals is proposed.
- A sufficient stability condition for the proposed BFLNN filter is derived.
- Numerous simulations considering the problems of cross-terms and acoustical feedback in the presence of different reference signals and acoustic paths are used to demonstrate the improved performance

Abstract

The actual active noise control (ANC) systems often exist some nonlinearity in such cases: (1) the reference signals are chaotic noise; (2) the primary path is nonlinear; (3) the secondary path is nonlinear or non-minimum phase. To solve these problems, the well-known functional link neural network (FLNN) filter using trigonometric expansions is applied successfully in nonlinear ANC (NANC) systems. However, the FLNN filter still has some limitations, for example it does not have the ability to solve the problems of cross terms and acoustical feedback. For modifying the performance of FLNN filter, we propose a new bilinear FLNN (BFLNN) filter combining the trigonometric function expansion, feedback output signals and the products of input signals and feedback output signals. The proposed BFLNN filter is based on a recursive structure which can represent the real nonlinear systems with fewer coefficients than non-recursive models do. Moreover, to some extent the recursive structure can compensate the acoustical feedback between reference microphone and secondary speaker. However, considering the stability of the recursive structure, this paper also offers a sufficient stability condition for the proposed BFLNN filter. Through analysis, the products of input signals and output signals can provide more comprehensive expression for cross-term problem. To demonstrate the effectiveness of the proposed BFLNN filter, numerous simulations considering the problems of cross terms and acoustical feedback in the presence of different reference signals and acoustic paths are conducted in simulation section, and the results prove that the proposed BFLNN filter is more suitable for NANC systems.