Fraunhofer IDMT

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Elektroakustik und Audiosignalverarbeitung 3

Adaptive Automatic Compensation of Transducer Nonlinearities Using Extremum-Seeking Control

Oral presentation

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In many applications, signal distortions effected by nonlinear input-output transducer characteristics pose a significant problem. Loudspeaker nonlinearities, for example, can impair audio quality to an unacceptable degree, when the systems are driven in the large signal domain. With electrostatic loudspeakers, the tried-and-true approach for dealing with transducer nonlinearities mainly the Coulomb force has been to increase the DC bias voltage to optimize the operating point of the force-voltage characteristic of the system. At the optimized operating point, the system is driven in the small signal domain. This approach carries some disadvantages regarding the cost of electrical components and efficiency.

This article proposes a signal processing method for the adaptive automatic compensation of electrostatic transducer nonlinearities that enables lower DC bias voltages as well as large signal domain driving of the transducer with low levels of nonlinear distortion. It is based on a predistortion of the input signal by parameterized inversions of polynomial characteristics. Adaptive behavior of the predistortion is achieved by real-time optimization of its parameters through extremum-seeking control with a cost function that estimates the amount of nonlinear distortion. This approach is evaluated with respect to its performance and stability for different operating points and input signals.