Abstracts

A Scattering Variable Approach to the Volterra Analysis of Nonlinear Systems

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A new mathematical model is developed which extends Volterra series analysis of nonlinear systems with memory to high-frequency systems, including those containing linear distributed component devices. A generalized set of nonlinear scattering parameters is defined which can be used to describe power transfer and distortion in nonlinear multiports, and which reduce to the classical scattering parameters for linear networks. The methodology is based on Volterra functional series, and is most useful for the small-signal case where the response can be approximated by a finite number of terms of the series. Nonlinear scattering kernels, derived by extending the Volterra analysis, are simply related to previously developed nonlinear voltage and current Volterra kernels. For sinusoidal inputs nonlinear scattering parameters are defined which are shown to be particularly helpful when power relationships are studied. The principal applications are for microwave networks terminated in real-valued site reference impedances. To evaluate the average power dissipated in a load at some intermodulation frequency, the concept of nonlinear transducer gain is defined and shown to be proportional to the squared magnitude of a nonlinear scattering parameter. Examples are presented illustrating the analysis procedure for a tunnel diode reflection amplifier and for a linear lossless transmission line terminated by a non-linear network.

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