Estimating the BLA of MIMO sub-networks in simulations

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Complex systems usually consist of an interconnected network of more basic sub-systems. Examples can be found in many different disciplines like electric circuits, biological systems and flexible mechanical systems. Analysis of the sub-systems can give valuable information about how the global system operates. One can, for example, study the way disturbances propagate through the network to find the dominant source of non-linear distortion [1].

In this talk, we consider simulations of such interconnected sub-systems, more specifically: electronic circuits. Due to the port-based representation, classically used in this context, the sub-networks are all Multiple-Input Multiple-Output (MIMO) systems. The global system is excited by a single large signal (See figure below). This signal sets the non-linear operating point of the whole network.

The goal is to determine the Best Linear Approximation (BLA) of the sub-networks. The estimation of the MIMO BLA is a well-studied problem [3]. The classic techniques use orthogonal excitation signals, which require a multisine source for each input of the sub-system. Adding these extra excitation signals to the input of the sub-systems can potentially change the non-linear operating point of the whole network, and with it, the BLA.

We propose to use a different technique which requires no extra large-signal sources in the network. The proposed technique considers the input multisine as a periodic scheduling and linearises the circuit around that scheduling [2]. By studying the linearised behaviour for different phase realisations of the input multisine, we obtain the wanted BLA of the sub-network.

Besides removing the risk of changing the non-linear operating point, the linearisation-based technique has the additional benefit that less phase realisations are required to estimate the BLA. With an efficient implementation, this could lead to a drastic reduction in simulation time.

References

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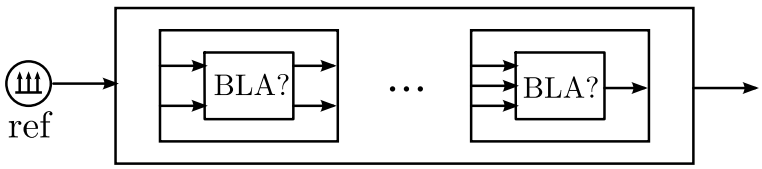

We consider an interconnection of MIMO systems where a single large-signal multisine sets the non-linear operating point. The goal is to determine the MIMO BLA of the sub-systems.

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