Real-Time Transistor Stability Measurements Using the Acceleration of the Gain for the Next Generation Radar

Lucilia Hays*(1), Charles Baylis(1), Robert J. Marks II(1), Ed Viveiros(2)
(1) Wireless and Microwave Circuits and Systems Program, Department of Electrical & Computer Engineering, Baylor University, Waco, TX, USA
(2) Army Research Laboratory, Adelphi, MD, USA

In the optimization of a reconfigurable power amplifier for power or power-added efficiency, the question of device stability should be considered. If a device is potentially unstable, the optimization of output power or efficiency could actually cause the device to move from a stable termination into oscillation, rendering the amplifier incapable of performing its function and potentially causing system damage. A method is required to detect potential instability early in a search, while the device remains stable, and keep the device in the stable region or stabilize the device before continuing the search.

This presentation shows how potential instability can be detected early in a real-time gradient load reflection coefficient search for PAE optimization. The acceleration of the gain is calculated based on measurement data as the real-time search progresses, and is used as a potential instability metric. If the load reflection coefficient is moving toward a potentially unstable region of the Smith Chart, the gain accelerates. Typically, there is an inflection point where the acceleration transitions from negative to positive as the region of instability is approached. Circuit simulation results show that the gain acceleration is shown to be a reliable indication of stable or unstable operation. The stability can be reliably evaluated through this method by the simple evaluation of additional neighboring points as the search progresses between candidate points.

This presentation also illustrates that curve-fitting applied to gain measurements can predict the location of unstable regions. Knowledge of the location of unstable regions is critical to ensure that only stable impedances are used for circuit reconfiguration.

Assessment of stability and detection of potential instability during gain and efficiency optimization is crucial to maintaining stable system performance in real-time amplifier reconfiguration.