GAIN GRADIENTS APPLIED TO DESIGN OF THE POTENTIAL PERFORMANCE TERMINATIONS FOR A MICROWAVE TRANSISTOR

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In this work, a typical design application of a microwave amplifier is presented with the determined feasible design space and applied gradient algorithm using analytical gain gradients. Physical lengths and characteristic impedances of the transmission lines used in the matching circuits are chosen as the design variables and their lower and upper limits are bounded by the limits of the planar transmission line technology, so that resulted microwave amplifier can be realized by this technology. Design Target Space is determined by the Compatible Performance [Noise (F), Input VSWR (V_i), Gain (G_T)] triplets and their source $Z_S(a_i)$ and load $Z_L(a_i)$ terminations resulted from the Performance Characterization theory of the active device. These triplets take into account the physical limitations of the device and eligibility conditions so that $F_{req} \geq F_{min}$, $V_{i\,req} \geq 1$, $G_{T\,min} \leq G_{T\,req} \leq G_{T\,max}$; and $Z_S(a_i)$ and $Z_L(a_i)$ terminations take place within the "Unconditionally Stable Working Area (USWA). Here, F_{min} is the minimum noise figure of the device and G_{Tmin}, G_{Tmax} are the minimum and maximum gain values constrained by F(noise) and V_i (Input VSWR) , which are also determined by the Performance Characterization theory. A simple design process is followed where the $Z_S(a_i)$ and $Z_L(a_i)$, i=1….N terminations are synthesized using the Darlington theorem. So optimization of the amplifier is reduced to the gain optimization of two passive, reciprocal two-ports. Gain of a matching circuit is expressed into the two alternative forms: (i) the function of ABCD parameters of the circuit; (ii) the function of mismatching in either port of the circuit. So for the gain gradients, the ABCD sensitivity method is used in the first form and the adjoint network technique is applied for the later. So the chosen potential performance [Noise (F), Input VSWR (V_i), Gain (G_T)] characteristics are realized by the simple optimization procedure with the efficient computation. Performance sensitivities of the T- and T- types of distributed parameter amplifiers are considered as a worked example. The numerical results of T- and II-type amplifiers for the design targets of noise figure F_{req}=0.46 dB and V_{ireq}=1, G_{Treq}=12 dB in the frequency range 4-11 GHz are given in comparison to each other. A typical design example is given synthesized, target, simulated with the resulted, characteristics. Finally, the complete analysis of the whole system is done using the optimized parameters and the resulted performance are compared with the results of a Professional soft packet and shown that all of them are agreed well.