Heuristic Approach to Optimization of a Microwave Amplifier

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Optimization is one of the fundamental processes frequently encountered in the engi-neering problems and is highly nonlinear in terms of the descriptive parameters of the system. An optimization process generally contains two fundamental problems:

First is to form a feasible Design Space which is defined in terms of the design variables and targets;

Second is that the global minimum of the error (objective) function governing the optimization must be obtained with respect to the design variables within the feasible design space.

For optimization of a microwave amplifier, design variables are generally the matching circuit parameters whose lower and upper limits are very often determined by the tech-nology to be utilized in the realization stage of the design. Nevertheless, design targets are still one of the main problems of the amplifier optimization. Generally, the optimiza-tion is focused on the transducer power gain (G_T) over a frequency band of operation without controlling the other performance criteria such as the noise (F), the input stand-ing wave ratio (V_i). Certainly, within the optimization process one can easily embed the desired performance goals without knowing the physical limits and / or compromise relations among F, V_i and G_T appropriately. Unfortunately this process often fails to attain the desired goals. However, the Neural Performance Data Sheets (NPDS) of the transistor overcomes all the above - mentioned handicaps and embeds the compati-ble (F, V_i, G_T) triplets with their source (Z_S) and load (Z_L) terminations together over a predetermined frequency band of operation. So optimization of a microwave amplifier is a multi – objective design problem with a mix of equality and inequality constraints.

Here the global minimum of the multi - objective function is searched in the two stages : (i) In the first stage, Genetic Optimization Algorithm is utilized to approach the global minimum within the given practical ranges of the design variables; (ii) In the sec-ond stage, Very Fast Simulated Reannealing (VFSR) algorithm is used to find out the local minimum around the initial values supplied by the random optimization algorithm.

Finally a worked example will be presented for the amplifier optimized by this method with the distributed input and output matching circuits to realize the target (F, Vi, GT) triplet.