Search Algorithm Comparison for Fast Optimization of Power Amplifier Load Impedance and Input Power

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The reconfigurability of a power amplifier allows it to adapt to specific operating requirements, such as power efficiency and spectral output. A power amplifier's ability to meet spectrum compliance has been shown to be directly related to both the input power and load impedance. This presentation presents multiple optimization techniques and compares their effectiveness in quickly obtaining a solution to stringent spectrum requirements. While the idea of optimization of both load impedance and input power is important, a search's ability to also tune the parameters such as bias and gate voltage is also useful. The Power Smith Tube (Barkate, WAMICON 2015) is useful in visualizing a simultaneous search for input power and load impedance in CAD, measurement-based design, or reconfigurable amplifiers.

We have recently shown that a gradient-based search has been effective in determining an appropriate operating location based on search criteria (Barkate, submitted to *IEEE Trans. Aerospace and Electronic Systems*, 2015). However, this gradient-based search suffers from the "curse of dimensionality" as the number of dimensions increases. A simplex search method utilizes a special polytope of n+1 vertices in n dimensions and is commonly applied to nonlinear optimization problems where the derivatives of the search space need not be known. This search method excels in three dimensional search spaces because less information is required to make a step toward the optimum. The pattern search is another method of numerical optimization and also does not require the gradient of the search space, thus requiring fewer measurements to move the operating location in higher dimensions. We demonstrate comparisons of these searches to optimize input power and load reflection coefficient in the Power Smith Tube (Figure 1). The three-dimensional results indicate that simplex and pattern searches may decrease the number of simulation or measurement queries required for multidimensional Smith Tube searches.

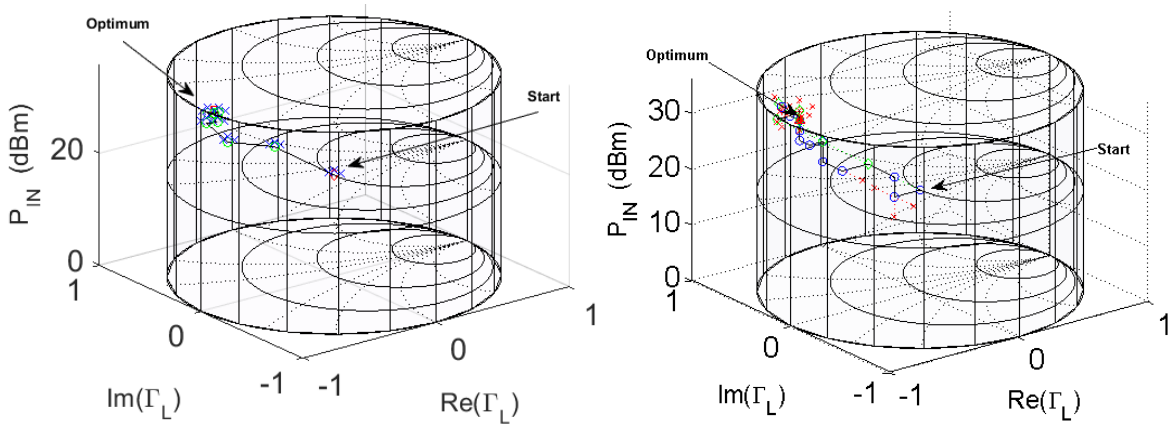

Figure 1: 3D Gradient based search vs a Pattern search in the input power smith tube. The gradient, pattern and simplex search landed within ±1% of the optimum operating location of 79% PAE, however the gradient based search took a total of 42 measurements whereas the Simplex and the pattern search only took 31 and 30 measurements respectively.