Success Story

University of Peradeniya Students Win ICIIS Award for Unique Coupler Design Using NI AWR Software

Company Profile

The University of Peradeniya is a state university in Sri Lanka, funded by the University Grants Commission. It was established as the University of Ceylon in 1942.

The Design Challenge

Wideband couplers have many practical applications at microwave frequencies. If realized in an inhomogeneous medium such as microstrip, these couplers yield poor directivity, which results in severe performance degradation. One of the major reasons for poor directivity is the mismatch in the odd and even mode phase velocities, along the coupled lines. Several methods have been suggested for compensating for the phase velocity mismatch, but these are limited to narrow bandwidths. The undergraduate design project described in this success story investigates the design and simulation of a unique wideband coupler that improves directivity by increasing the number of stages of the coupled line coupler, thus resulting in a multistage coupler, which improves bandwidth performance and, with optimally positioned capacitances, delivers improved directivity and phase compensation.

The Solution

Several 20 dB (coupling factor) couplers were designed and analyzed on a Neltec NX9320 substrate, as shown in Figure 1. A key factor in the success of this project was the optimization of the positioning of multiple capacitors along the coupler, as shown in Figure 2.

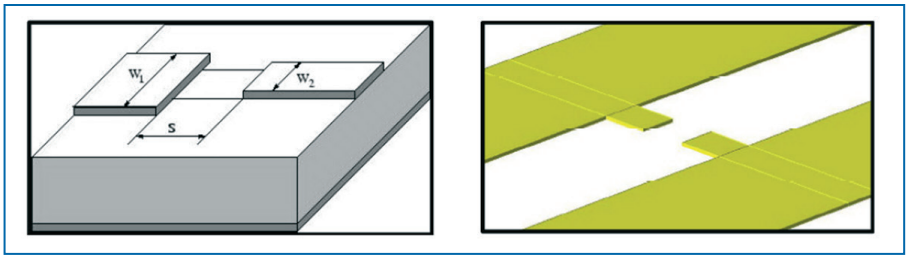

Figure 1: Symmetrical microstrip gap layout.

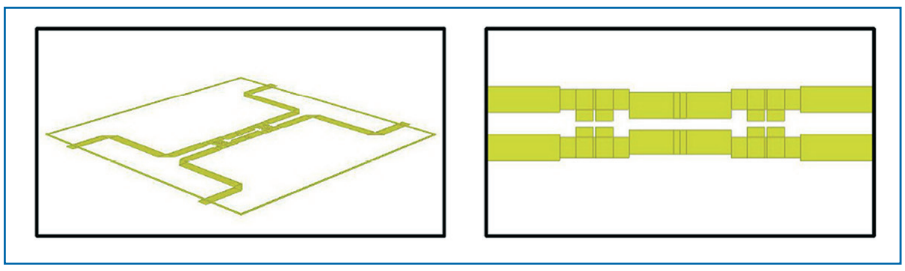

Figure 2: In order to further enhance the directivity, a multiple number of capacitors were placed on the coupler and their positioned optimized.

Application:
Wideband Asymmetric Coupler
Software:
NI AWR Design Environment
Microwave Office

"I use NI AWR software extensively in the undergraduate projects I supervise. In particular, the wideband asymmetric coupler project was submitted as a paper at the IEEE International Conference on Industrial and Information Systems in December 2014 and won the second best paper award."

– Dr. Aruna Gunawardena
Senior Lecturer
University of Peradeniya, Sri
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NATIONAL INSTRUMENTS

The positions of the capacitors were optimized with respect to the bandwidth-directivity performance and considerations of the coupling factor and the input port reflection. The optimization process relied on minimizing the cost function by employing the pointer-robust optimization approach, which yielded a significant improvement over the previous approaches for both the symmetric and asymmetric couplers.

The design team used NI AWR Design Environment™ Microwave Office circuit design software for these simulations.

Microwave Office offers a unique pointer-robust algorithm, which enabled the designers to achieve pointer-robust optimization of the capacitors. The pointer optimizer combines the power and robustness of four widely used and accepted search methods (linear simplex, downhill simplex, sequential quadratic programming, and genetic algorithm) with ease of use and an automated training feature. This self-training ability enables the pointer optimizer to determine the best search procedure for a given problem. The process of training almost always finds the true global optimum.

The target objectives and an allowable number of iterations for the optimization were specified. The best combination of optimizers and step sizes were obtained from the optimization process. The quality of the performance of the coupler was measured by the cost function, which is a measure of the error of the measured value to the optimization goals. By minimizing the cost function, the quality of the coupler can be improved. The designers successfully improved the directivity of the coupler by minimizing the cost function while maintaining the wideband coupling factor of -20 dB.

A paper written on this design achievement was presented at the IEEE 9th International Conference on Industrial and Information systems held in India in December, 2014 and won the second best paper award.

Why NI AWR Design Environment

NI AWR Design Environment was chosen for this project because its ease of use, as well as the unique pointer-robust algorithm, which enabled the undergraduate design team to achieve a complex design that solved a unique problem.