Success Story

MTUCI Students Design Microwave Filters Using NI AWR Software

"The ease of use of the NI AWR Design Environment platform enables my students to quickly get the first results and makes it an ideal tool for skill learning and development."

Oleg Arinin, Moscow Technical University of Communication and Informatics

Company

Moscow Technical University of Communication and Informatics (MTUCI) in Moscow, Russia is a large educational and scientific center for the training of highly qualified specialists in the field of telecommunications, informatics, radio engineering, economics, and management. The history of the university, as a higher educational institution, began in February 1921. To date, the university has about 14,000 intramural and extramural, bachelors, graduate, and postgraduate students.

At-A-Glance

Application
- Filter

Software
- NI AWR Design Environment
- Microwave Office

Benefits
- Ease of use
- Career development
- Availability of software

Challenge

The university's goals for its engineering students include training undergraduates in the basics of working with professional software and training graduate students in the design of passive microwave circuits within the discipline of microwave techniques.

The challenge in this project was to investigate the potential selective capabilities of a new type of structure and simulate a highly selective microstrip microwave filter on that basis. Synthesis of new structures inherently has certain difficulties, since purely analytical methods do not allow for designers to obtain the required result and a full-wave 3D electromagnetic (EM) simulation significantly increases the design time and makes it difficult to analyze the potentialities of the structure.

Solution

Under the guidance of the Professor G. M. Aristarkhov, undergraduate student I. N. Kirilov and graduate student O.V. Arinin designed a highly selective filter.The students chose the NI AWR Design Environment platform, specifically Microwave Office circuit design software, for the initial analysis of the structure. The software made it possible to quickly and accurately analyze the capabilities of this structure and achieve an increased frequency selectivity compared to traditional comb structures with additional EM couplings between non-adjacent resonators.

A distinctive feature of the examined structure was the opposite connection of the comb sections, their EM coupling, and the additional galvanic connection between the comb sections (a microstrip bridge between the third and fourth resonators). Thus, in this structure, two ways of increasing the order of the filters were realized simultaneously, both due to the EM coupling between the resonators, and due to the galvanic connection between them. This made it possible to design a compact highly-selective filter with a limited number of resonators.

Both designed filters were made on a substrate with a relative permittivity ε_r=9.8 and thickness h=1 mm. In the multistep six-resonator structure shown in Figure 1, due to the EM coupling between all the resonators, only three working attenuation poles were formed at finite frequencies. Additionally, the inclusion of a galvanic connection enabled the designers to form three more working attenuation poles and to reduce the dimensions of the filter. The areas of the filter substrates were S_1=605 mm^2 for the structure shown in Figure 1, and S_2=472 mm^2 for the structure with an additional galvanic connection shown in Figure 2.

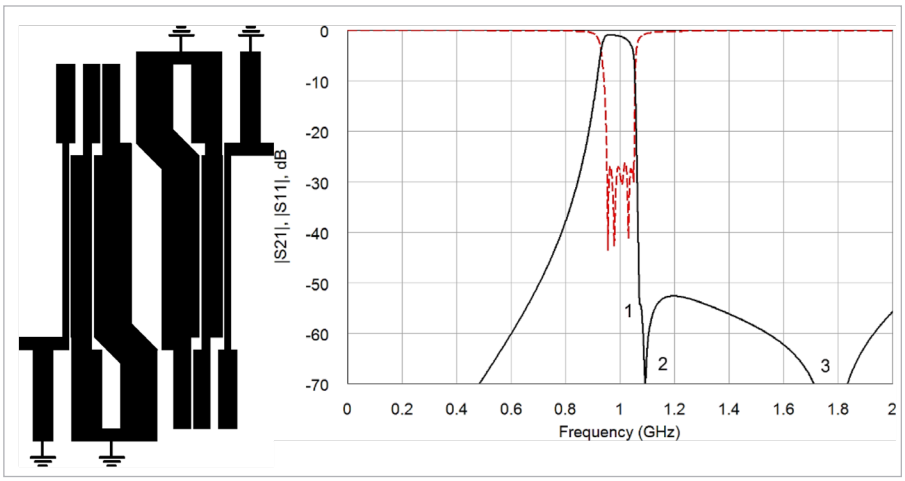

Figure 1: Counter-comb structure of a six-resonator microstrip filter (MSF) with increased one-sided frequency selectivity.

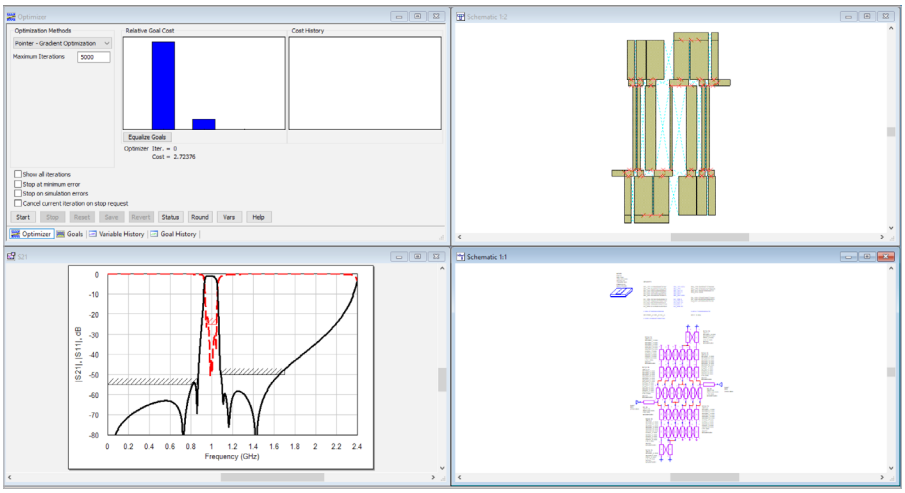

Figure 2: Structure of the six-resonator MSF with galvanic connection.

Conclusion

NI AWR Design Environment software was chosen for this project because the students have ready access to the complete suite of tools through the AWR University Program and use the software regularly in their engineering courses. The simple and intuitive user interface enables them to easily learn how to work with modern software for developing communication systems and it offers a full set of tools for the design of both individual circuits and full communication systems. NI AWR software has enabled the students to complete their assigned tasks and to concentrate on gaining knowledge and skills.

Note: The design discussed in this success story was also presented at the Systems of Signal Synchronization, Generating and Processing in Telecommunications (SYNCHROINFO) Conference, Microstrip filters based on counter-comb structures with additional galvanic connection, by G. M. Aristarkhov, O. V. Arinin, and I. N. Kirillov. It can be downloaded by IEEE members on IEEE Xplore at ieeexplore.ieee.org/document/8456933.