

자연계 최적법칙에 기반한 마이크로파 필터 설계법

이창형, 조정현, 서예준, 전문수, 이경민, 강승택

인천대학교

S-kahng@inu.ac.kr

Nature-Inspired Optimization for Microwave Filter Designs

Changhyeong Lee, Junghyun Cho, Yejune Seo, Munsu Jeon, Gyungmin Lee,
Sungtek Kahng

Incheon National University

Abstract

In this paper we present a stochastic optimization process based on genetic algorithm for filter synthesis. An L-band fourth order filter is designed and tested using the proposed algorithm.

I. Introduction

Microwave filters play an important role in the wireless communication system. Chebyshev and Elliptic class of filtering function have found frequent application within the space of microwave communication system. The generic features of amplitude in band characteristics together with the sharp cutoff skirts gives an acceptable compromise between lowest signal degradation and highest interference rejection [1].

A filter can be design using transfer function by giving number of poles and zeros. The order of the filter depends on the number of poles. The number of zeros in the in the stop band region plays an important role in the performance of the filter. A filter can be synthesized by different methods. One of them which is being followed here is Genetic Algorithm (G.A.) optimization under the framework of Matlab. We have proposed the idea of synthesizing of filter by GA to obtain the location of poles and zeros.

II. Proposed Synthesis Method

To verify the proposed filter synthesis method, it is applied to a symmetric 4th order L-band filter having four poles in the passband and two zeros in the lower and upper stop band regions.

$$s_{21}(s) = \frac{P(s)}{\varepsilon E(s)}$$

Where ε is the ripple factor and 's' is the complex frequency variable, $E(s)$ is the polynomial of the poles and $P(s)$ is the polynomial of the zeros.

$$\begin{aligned} \text{cost function} = & \sum_{n_1=1}^{N_1} |S_{21\text{spec.}}(f_{n_1}) - S_{21\text{tried}}(f_{n_1})|^2 \\ & + \sum_{n_2=1}^{N_2} |S_{21\text{spec.}}(f_{n_2}) - S_{21\text{tried}}(f_{n_2})|^2 \end{aligned}$$

Figure 1 shows the normalized and real frequency

response for the fourth order L-band filter over the frequency range of 1.67 GHz to 1.72 GHz. The return loss achieved is below -20 dB. The right end of Figure 1 shows the cost function error which is 5.4960 after 80 alterations.

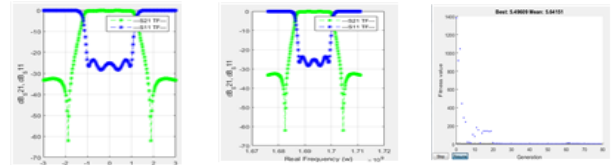


Figure 1. Frequency responses and cost function error

III. Conclusion

In this paper a simple and efficient method for the synthesis of microwave filters has been presented. The synthesis procedure includes transfer function for the optimization of filters using genetic algorithm in the framework of Matlab.

ACKNOWLEDGMENT

This work was supported by the national project of Korean aerospace research institute.

References

- [1] Richard J. Cameron, "General Coupling Matrix Synthesis Methods for Chebyshev Filtering Functions", IEEE Transaction on Microwave, Theory and Tech., Vol. 47, No. 4, April, 1999.
- [2] Sungtek Kahng et al, "A Dual-Mode Narrow-Band Channel Filter and Group-Delay Equalizer for a Ka-Band Satellite Transponder", ETRI Journal, vol. 25, no. 5, Oct. 2003, pp.379-386.