Automatic Design of Analog Filter Using Genetic Algorithm

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In this paper, we propose a method that automatically designs an analog filter to satisfy target specification. Using a genetic algorithm, circuits that satisfy target specification can automatically be identified. Moreover using this method output of any phase can be achieved for the analog filter working in any frequency band. For example, this method has been used to automatically design the analog filter that generates constant phase of -π/6[rad] and π/6[rad] for a frequency band of 100MHz to 300MHz. In this case relative errors of target phase was less than 5%.

Specifications for the analog circuit have been challenging rapidly in recent years. However, the more complicated the circuit configuration becomes, the more difficult it gets for a person to design. Therefore the automatic design by the computer is required. This method can be expected to design complex circuits quickly. In addition, it is considered to be able to automatically design poly phase filters [1] that can be used for image rejection.

A superior gene survives, while an inferior gene is been weeded out in the process of biological evolution. This process expressed in algorithm is called the genetic algorithm [2]. The genetic algorithm has been constructed based on the laws of heredity in the real world. The genetic algorithm is the method that tries to find the optimal solution for the problem.

We describe the basic circuit configuration necessary for automated design. Fig. 1 shows the configuration circuit. In this circuit, using the switch operation of ON and OFF, a variety of circuit configuration is possible. Utilizing capacitor and resistor values and switching technique perform genetic operation.

Automatically designed analog circuit, shown in Fig. 2, generates output of constant phase of-π/6[rad] at terminal *Vout1* and π/6[rad] at terminal *Vout2*. Fig. 3 shows phase characteristics of circuit shown in Fig. 2 for the frequency band of 100MHz to 300MHz.

From the characteristics of Fig. 3, we can see that for frequency band of 100MHz to 300MHz, the target specification of constant phase has been fulfilled.

In conclusion, we have proposed an automated design of an analog filter that satisfies target specification. By utilizing this new designing method, automatic designing of various kinds of Filter circuit is possible.

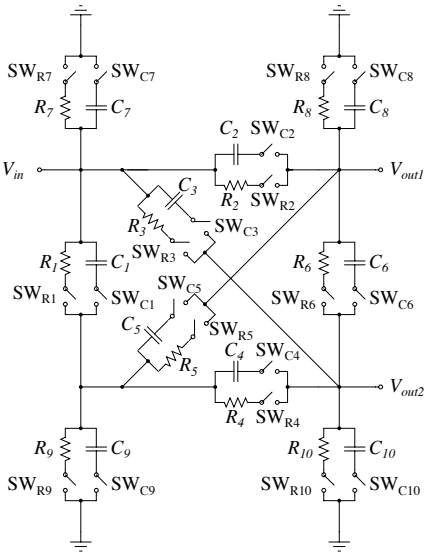

Fig. 1 Circuit configuration to apply the genetic algorithm.

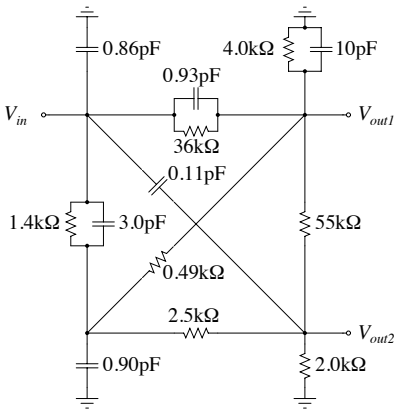

Fig. 2 Automatically designed circuit.

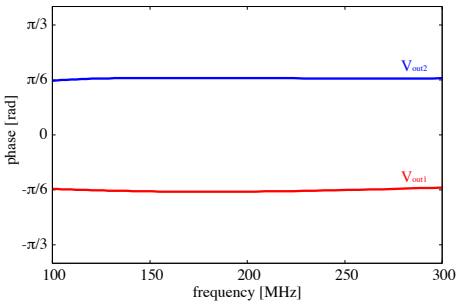

Fig. 3 Phase characteristics of the filter in Fig 2.

[1] H. Kobayashi, J. Kang, T. Kitahara, S. Takigami, H. Sakamura, "Explicit Transfer Function of RC Polyphase Filter for Wireless Transceiver Analog Front-End", 2002 IEEE Asia-Pacific Conference on ASICs, pp.137-140, Taipei, Taiwan (Aug. 2002).

[2] D. E. Goldberg, K. Sastry, Genetic Algorithms: The Design of Innovation, 2nd edition, Springer (2010).