

**EXTREMAL: A COMPUTER PROGRAM FINDING EXTREME PARAMETERS OF DIGITAL AND ANALOG FILTERS**

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A minimal filter order ( $N$ ) is determined by initial parameters of the magnitude frequency response of the filter. Frequently there is an opportunity of an improvement of these parameters. Besides such opportunity can be received by purposely increase of the minimal value  $N$ .

Before the developer there is a problem of a choice of initial parameters for calculation of the filter. Initial parameters of the filter response are the passband ripple, the minimal stopband attenuation, the passband and stopband edge frequencies.

There is a space of tolerable initial parameters. The form and dimension of the space depends on filter type (lowpas, bandpass or other) and on used approximation of its response. The calculation of the filter for any point of the space will result to the tolerable response.

In engineering practice we usually aspire to define the extremely improved value of one of parameters at set the others [1-4]. For example, the passband ripple can be extremely reduced or the passband is extremely expanded without infringement of requirements to the response.

This work presents a computer program "Extremal"(company "RADIS Ltd") for calculation of extreme parameters of digital and analog lowpas, highpass, bandpass, bandstop filters with Butterworth, Chebyshev and Zolotarev-Cauer approximations. The program finds extreme parameters for 7 variants of lowpas or highpass filter responses and 11 variants of bandpass or bandstop filter responses. The program based on equations from [2, 3].

The variants of responses with extreme parameters for lowpass and highpass filters are the minimum of the maximal weighed error; the minimal passband ripple; the maximum of the minimal stopband attenuation; the maximal narrow transition width at the nominal passband; the maximal wide passband; the minimal ripple in some part of the passband; the maximum of the minimal attenuation in some part of the stopband.

The variants of responses with extreme parameters for bandpass and bandstop filters are the minimum of the maximal weighed error; the minimal passband ripple; the maximum of the minimal stopband attenuation; the maximal narrow transition width at the nominal passband; the maximal expansion of the passband at the left; the maximal expansion of the passband on the right; the maximal symmetric expansion of the passband; the minimal ripple in the right part of the passband; the minimal ripple in the left part of the passband; the minimal ripple in the middle part of the passband for bandpass filters and the minimal ripple in two passbands of bandstop filters except for intervals adjoining to transition bands; the maximum of the minimal attenuation in some part of the stopband.

In the program Extremal the minimal filter order is determined. It can be changed aside increases and back at simultaneous observation over change of the extreme response parameters.

The program allows to operate flexibly with the initial parameter and order values for various digital and analog filters with the purpose of achievement of desirable responses. Extremal is useful and easy-to-use auxiliary tool for developers of the radio-electronic equipment.

#### References

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