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ASYMPTOTIC EFFECTIVENESS OF GENERALIZED V-FILTERS, (U)
MAR 77 V T DOLGOCHUB, M B SVERDLIK
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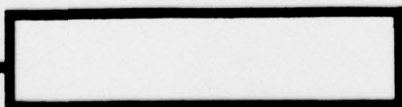
by

V. T. Dolgochub, M. B. Sverdlik



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By: V. T. Dolgochub, M. B. Sverdlik

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| Block | Italic | Transliteration | Block | Italic | Transliteration |
|-------|-------------------|-----------------|-------|-------------------|-----------------|
| А а | <i>А а</i> | A, a | Р р | <i>Р р</i> | R, r |
| Б б | <i>Б б</i> | B, b | С с | <i>С с</i> | S, s |
| В в | <i>В в</i> | V, v | Т т | <i>Т т</i> | T, t |
| Г г | <i>Г г</i> | G, g | У у | <i>У у</i> | U, u |
| Д д | <i>Д д</i> | D, d | Ф ф | <i>Ф ф</i> | F, f |
| Е е | <i>Е е</i> | Ye, ye; E, e* | Х х | <i>Х х</i> | Kh, kh |
| Ж ж | <i>Ж ж</i> | Zh, zh | Ц ц | <i>Ц ц</i> | Ts, ts |
| З з | <i>З з</i> | Z, z | Ч ч | <i>Ч ч</i> | Ch, ch |
| И и | <i>И и</i> | I, i | Ш ш | <i>Ш ш</i> | Sh, sh |
| Й й | <i>Й й</i> | Y, y | Щ щ | <i>Щ щ</i> | Shch, shch |
| К к | <i>К к</i> | K, k | Ъ ъ | <i>Ъ ъ</i> | " |
| Л л | <i>Л л</i> | L, l | Ы ы | <i>Ы ы</i> | Y, y |
| М м | <i>М м</i> | M, m | Ь ь | <i>Ь ь</i> | ' |
| Н н | <i>Н н</i> | N, n | Э э | <i>Э э</i> | E, e |
| О о | <i>О о</i> | O, o | Ю ю | <i>Ю ю</i> | Yu, yu |
| П п | <i>П п</i> | P, p | Я я | <i>Я я</i> | Ya, ya |

*ye initially, after vowels, and after ъ, ь; e elsewhere.
 When written as ё in Russian, transliterate as yë or ë.
 The use of diacritical marks is preferred, but such marks may be omitted when expediency dictates.

GREEK ALPHABET

| | | | | |
|---------|-----|---|---------|-------|
| Alpha | Α α | • | Nu | Ν ν |
| Beta | Β β | | Xi | Ξ ξ |
| Gamma | Γ γ | | Omicron | Ο ο |
| Delta | Δ δ | | Pi | Π π |
| Epsilon | Ε ε | • | Rho | Ρ ρ ϑ |
| Zeta | Ζ ζ | | Sigma | Σ σ ς |
| Eta | Η η | | Tau | Τ τ |
| Theta | Θ θ | • | Upsilon | Υ υ |
| Iota | Ι ι | | Phi | Φ φ ϕ |
| Kappa | Κ κ | • | Chi | Χ χ |
| Lambda | Λ λ | | Psi | Ψ ψ |
| Mu | Μ μ | | Omega | Ω ω |

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

| Russian | English |
|-----------|--------------------|
| sin | sin |
| cos | cos |
| tg | tan |
| ctg | cot |
| sec | sec |
| cosec | csc |
| sh | sinh |
| ch | cosh |
| th | tanh |
| cth | coth |
| sch | sech |
| csch | csch |
| arc sin | sin ⁻¹ |
| arc cos | cos ⁻¹ |
| arc tg | tan ⁻¹ |
| arc ctg | cot ⁻¹ |
| arc sec | sec ⁻¹ |
| arc cosec | csc ⁻¹ |
| arc sh | sinh ⁻¹ |
| arc ch | cosh ⁻¹ |
| arc th | tanh ⁻¹ |
| arc cth | coth ⁻¹ |
| arc sch | sech ⁻¹ |
| arc csch | csch ⁻¹ |
| — | |
| rot | curl |
| lg | log |

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ASYMPTOTIC EFFECTIVENESS OF GENERALIZED $\sqrt{}$ -FILTERS

V. T. Dolgouchub and M. B. Sverdlik

A method of synthesizing filters which maximize the ratio (σ) of the square of the peak modulus to the sum of the squares of the side lobe moduli in a certain range of the reciprocal ambiguity function was proposed in [1]. One version of the realization of these filters, called generalized $\sqrt{}$ -filters, consists of a delay line (DL) [13] with leads to which complex weighting factors are connected. The duration (T_0) of the filter's pulse response can be equal to or greater than the signal length (T_e), while the intervals between the leads (τ_n) are equal to or shorter than the discrete (τ_d) signal length. The smoothing filter at the outlet of the DL is matched with interval τ_n .

Report [1] showed that parameter σ is the nondecreasing function of ratio T_ϕ/T_c . The analysis of the output signals of the calculated filters showed that parameter σ essentially increases with the increase in T_ϕ/T_c ; parameter μ (the ratio of the peak to the maximum side loop) also increases simultaneously, while ρ (the normalized signal/noise ratio) decreases. The main peak narrows and parameters δ , μ and ρ decrease as interval τ_n decreases.

It is convenient to estimate the asymptotic efficiency of generalized ∇ -filters by comparing them with the well-known Mosk and Urkovits filters.

Theoretically, this filter [2] makes it possible to suppress the side lobes of the output signal to the zero level (here $\delta = \infty$, $\mu = \infty$). However, the pulse response of this filter cannot be realized. In view of the behavior of parameters σ and μ , we can assume that ∇ -filters asymptotically approximate Mosk filters at $\tau_n = \tau_n$ and with the increase in ratio T_ϕ/T_c . To confirm this assumption, we calculated the root-mean-square deviation ϵ of the frequency characteristics of generalized ∇ -filters from those of the Mosk filter. Figure 1 shows the dependence of ϵ on T_ϕ/T_c for a 15-position biphase signal. The curve shows that the value of ϵ actually decreases with the increase in T_ϕ/T_c ; at $T_\phi/T_c = 3$ the value of ϵ is already forty times smaller than that of ϵ at

$T_\phi/T_c=1$. At $T_\phi/T_c=3$ the parameters of the output signal from the generalized V-filter assume the values $\sigma = 177$, $\mu = 28$, $\rho = 0.78$.

Thus, it follows that the asymptotic estimate of parameter ρ of a generalized V-filter is determined by the value of parameter ρ of the Mosk filter. For the example in question, the asymptotic value of $\rho_{\text{аспт}} \approx 0.66$.

Thus, generalized V-filters with controlled pulse response time make it possible to realize virtually any approximation of Mosk filters.

The frequency characteristic $\Phi(j\omega)$ of the well-known Urkovits filters is defined as [3]

$$\Phi(j\omega) = S^*(j\omega) / |S(j\omega)|^2,$$

where $S(j\omega)$ is the signal spectrum.

It is obvious that with this form of the frequency characteristic and infinite widening of the spectrum, the output signal is a delta function, while parameters $\sigma = \infty$, $\mu = \infty$, $\rho = 0$.

Urkovits filters are optimum for isolating signals against a background of reflections off local objects; however, they cannot be

realized in practice.

Since the passband of a generalized ∇ -filter widens with the decrease in interval τ_n , the duration of the output signal peak decreases, which makes it logical to assume that generalized ∇ -filters approximate Urkovits filters during asymptotic widening of the passband ($\tau_n \rightarrow 0$). Indeed, the analysis of the frequency characteristics confirms this hypothesis.

The comparison with Urkovits filters was made in the area under the frequency characteristics in sections

$$0 \leq f_1 < 1/\tau_n, 1/\tau_n < f_2 < 2/\tau_n, 2/\tau_n < f_3 < 3/\tau_n.$$

Figure 2 shows graphs of the redistribution of area depending on the interval τ_n at $T_\phi = T_c$. As the graphs indicate, the nature of the redistribution indicates the approximation of the generalized ∇ -filters to the Urkovits filter.

However, we must keep in mind that widening the passband of generalized ∇ -filters at $T_\phi = T_c$ causes an increase in the side lobe level. Therefore, it is necessary to increase ratio T_ϕ/T_c in order to decrease the side lobe level.

Thus, we can say that generalized ∇ -filters asymptotically

approximate Urkovits filters with the increase in ratio T_ϕ/T_c and widening of the passband; therefore, they can be considered to be the practical realization of the approximation of Urkovits filters with controlled memory and passband.

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Fig. 1. Root-mean-square deviation of frequency characteristics of generalized ψ -filters and Mosk filter ($\tau_H = \tau_A$).

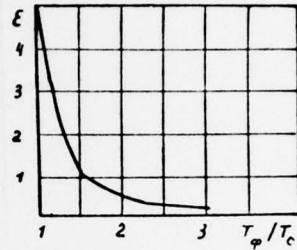
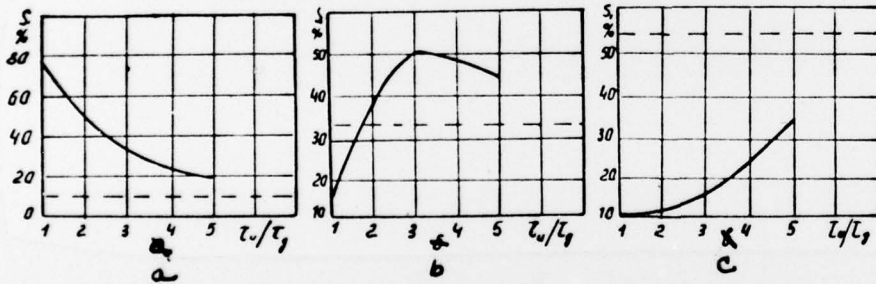


Fig. 2. Graphs of redistribution of area under frequency characteristics of generalized ψ -filters ($T_\phi = T_c$, the broken line shows the area of the corresponding section for the Urkovits filter): a, b, c - sections f_1 , f_2 and f_3 , respectively.



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