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AUTHOR: Dubrov, Ya. A.

TITLE: Bessel functions and orthogonal polynomials as transfer agents in communications systems

PERIODICAL: Referativnyy zhurnal. Matematika, no. 10, 1962, 56, abstract 10V280 (In collection: Avtomat. kontrol' i izmerit. tekhn. no. 5, Kiyev, AN USSR, 1961, 46-54)

TEXT: For communications systems using linear selection the transmitted signal takes the form

$$f(t) = \sum_{0}^{n} a_k f_k(t), \qquad (1)$$

where the functions $f_k(t)$ are linearly independent over the range $[0, T]$ occupied by the transmitted information. By analysis of the signal over the range $[0, T]$ it is possible, when there is no noise, to regenerate the signal $f(t)$ unambiguously, i.e. to determine the number a_k. The f_k generally used are $e^{ik\omega t}$ functions, where ω is the set frequency. The
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possibility is investigated of using $I_p(z_k t)$ Bessel functions, where z_k are the roots of the equation $I_p(zT) = 0$, as f_k, as well as the possibility of using Jacobi, Hegenbauer, Chebyshev and Legendre polynomials for the same purpose. In order to create the corresponding communications system the possibility of generating f_k functions at the receiving end needs to be examined. For this purpose, linear passive four-terminal networks can be used if their inputs are supplied with a single pulse $V(t)$, where $V(t)$ is equal to zero at $t > 0$ and equal to unity at $t < 0$. When using a Bessel function it is best to generate $t^{1/2} I_p(z_k t)$ functions so as to avoid having to generate, at the receiving end, the weighted function $\varphi(t) = t$ necessary for picking out the elementary signal by using the orthogonality of $t^{1/2} I_p(z_k t)$. The Laplace transform of the function $t^{1/2} I_p(z_k t)$ can be expressed by a hypergeometric function. It is desirable to select $p = 2n + 5/2$ or $p = - 2n - 3/2$ since in this the hypergeometric series is broken, which is necessary in order to be able to realize the corresponding four-terminal network. It is also possible to realize the
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four-terminal networks for the other sets of f_k under discussion, since the Laplace transform of $f_k(t)$ is a generalized hypergeometric function; but the corresponding communications systems then becomes more complex as the weighted function has to be generated at the receiving end. Two forms of modulation are possible using (1) signals. In "amplitude" modulation each channel is ascribed a definite term of the sum (1) with a "frequency" z_k, whilst in "frequency" modulation each channel is ascribed n "frequencies", the "frequencies" of the different channels' functions not overlapping. The author considers the $t^{1/2} I_p(z_k t)$ set of functions to be the most convenient. [Abstracter's note: Complete translation.]