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APPLICATION OF INVERS PROBLEM SOLUTIONS OF THE LINEAR AUTOREGRESSIVE PROCESSES FOR POWER EQUIPMENT VIBROMONITORING

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Author

Zvarich V.

Institute of electrodynamics Academy of Science of Ukraine,
Peremohy av., 56, Kyiv-057, 03680, Ukraine,
e-mail: zvaritch@nas.gov.ua

A method is suggested for definition the characteristic function of the generative process $\{\zeta_t, t \in Z\}$ *for linear autoregressive AR(2) processes with negative binomial distribution, namely, autoregressive process AR(2)* $\xi_t + a_1\xi_{t-1} + a_2\xi_{t-2} = \zeta_t$, $t \in Z$, *where* $\{a_1, a_2 \neq 0\}$ *are autoregressive parameters;* $Z = \{\ldots,-1,0,1,\ldots\}$ *is a set of integers;* $\{\zeta_t, t \in Z\}$ *is the random process with discrete time and independent values having an infinitely divisible distribution. This process is often called the generating process. A method of Negative Binomial AR(2) generative process characteristic function determination is discussed. Sometimes the problem is called inverse problem. The logarithm of the one-dimensional characteristic function of the linear stationary autoregressive process may be determined in Kolmogorov canonical representation* $\ln f_\xi(u,t) = \ln f_\xi(u,1) = i m_\xi u + \int_{-\infty}^{\infty} \left(e^{iux} - 1 - iux\right) \frac{dK_\xi(x)}{x^2}$, *in which the parameter* m_ξ *and spectral functions of jumps* $K_\xi(x)$ *define unequivocally the characteristic function. The logarithm of the characteristic function of the linear stationary autoregressive process may be written down also in the following form* $\ln f_\xi(u,t) = \ln f_\xi(u,t) = i m_\zeta u \sum_{\tau=-\infty}^{\infty} \varphi(\tau) + \sum_{\tau=-\infty}^{\infty} \int_{-\infty}^{\infty} \left(e^{iux\varphi(\tau)} - 1 - iux\varphi(\tau)\right) \frac{dK_\zeta(x)}{x^2}$ *where the parameters* m_ζ *and* $K_\zeta(x)$ *define the characteristic function of the generative process* ζ_t *while* $\varphi(\tau)$ *is the kernel of the linear random process* ξ_t. *The parameters* m_ξ *and* m_ζ, *and Poisson spectra of jumps* $K_\xi(x)$, $K_\zeta(x)$ *are interrelated as follows* $m_\xi = m_\zeta \sum_{\tau=0}^{\infty} \varphi(\tau)$, $K_\xi(x) = \int_{-\infty}^{\infty} R_\varphi(x,y) dK_\zeta(y)$ *where* $R_\varphi(x,y)$ *is so-called transform kernel, which is invariant with generative process* ζ_t *and uniquely defined by the coefficients* $\{a_1, a_2 \neq 0\}$. *Properties of* $R_\varphi(x,y)$ *are used for the inverse problem solution. Examples the peculiar features of determination of Poisson spectra of jump and characteristic function for the autoregressive AR(2) process are considered. Logarithm of characteristic function for linear AR(2) process with negative binomial distribution was calculate. It is equaled to*

$$\ln f_\zeta(u;t) = |t| \ln f_\zeta(u;1) = ir|t| \left\{ \frac{q}{p} \left| \sum_{\tau=-\infty}^{\infty} \varphi(\tau) \right|^{-1} u + \left[\sum_{\tau=-\infty}^{\infty} \varphi^2(\tau) \right]^{-1} \sum_{k=0}^{\infty} q^k \frac{1}{k} (\exp iuk - 1 - iuk) \right\}.$$

An example of application of vibration signal simulation of wind power generator is considered. References 14, figure 1.

Key words: linear autoregressive process, characteristic function, kernel of transformation, generative process, infinitely-divisible distributions, negative binomial distribution, vibration diagnosis of rolling bearings.

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