9) generalized characteristics of functions;
10) anuncertainty principle.

Each of these sections includes the following points:

- basic concepts;
- sequence of numbered formulas;
- special cases;
- the plots for given function parameters.

As a result, the formulas that presented in the handbook was adapted as lightweight algorithms [4] and was tested to create mathematical models in Data Mining computer systems and small memory mobile applications based on Android, iOSas well. It should be noted that mobile version of the handbook was created to test computational costs of the lightweight algorithms [4] and was registered as certificates of software registration in Federal Institute for Industrial Property [5].

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References

1. Prokhorov S.A., Kulikovskikh I.M. *Basic orthogonal functions and its applications. Part I. Orthogonal functions of exponential type*, Samara Section of Russian Academy on Science, 2013. – 192 p.
2. Weir C., Noble J. *Small Memory Software: Patterns for systems with limited memory*, Addison Wesley, 2000.
3. Jackson D. *Fourier series and orthogonal polynomials*, The Mathematical Association of America, 1941.
4. Kulikovskikh I.M., Prokhorov S.A. *Some lightweight algorithms for scientific computing in mobile technologies*, Proceedings at the conference on Applied Mathematics and Scientific Computing, Croatia, Sibenik, 2013, – pp. 40 – 41.
5. Kulikovskikh I.M., Prokhorov S.A., Majorov A.P. *Handbook on orthogonal function and its applications based on Android: orthogonal function of exponential type*, certificates of software registration № 2013660124 d.d. 10.24.2013.

S.A. Prokhorov, Y.V. Solovyova

THE COMPARATIVE ANALYSIS OF ORTHOGONAL MODELS CREATION RESULTS IN CASE OF DIFFERENT APPROACH APPLICATIONS TO THE ASSESSMENT OF CORRELATIVE SPECTRAL CHARACTERISTICS IN DIFFERENT ORTHOGONAL BASES

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The results of orthogonal models of correlative spectral characteristics creation are brought and analyzed in case of approximate and analytics-numerical approach

application to an assessment of expansion coefficients in the bases of Bessel, Laguerre, Jacobi, Legendre, Sonin-Laguerre, Dirichlet.

The creation of the correlative functions (CF) models and the spectral densities of power (SDP) is quite often carried out by means of orthogonal bases. Now in case of orthogonal models of the functional characteristics creation Laguerre, Legendre, Jacobi, Dirichlet orthogonal polynoms are used, as a rule. It is connected to that they are well studied and have explicit analytical idea. The choice of orthogonal base is one of the important and complex challenges the correct decision of which will dependthe accuracy of the received results. In the article [1] the solution of the task of correlative spectral characteristics models creation with use of Besselorthogonal functions of the first kind and of a zero order as system of basis functions is proposed.

The idea to usethese functions as orthogonal base in case of the solution of tasks of approximate correlative spectrum analysis of accidental processes arose in connection with broad application of Bessel functions in different areas of mathematical physics, applied mathematics, optics and signal processing that is caused by a row of properties which they possess, including ability precisely to approach different functional dependences, and, in particular, fading oscillatory processes.

During carrying out the researches it was clarified that Besselorthogonal functions have favorable approximate opportunities in comparison with earlier studied systems of basis functions, and their application as basis functions gives the chance to increase the accuracy of orthogonal models of correlative spectral characteristics of stationary accidental processes creation [1].

Besselorthogonal functions give the best results in case of creation of the CF models of the oscillatory look gradually fading on an interval of existence. It is connected to that already the first Bessel weighed orthogonal functions much more closer match the form of analysableCF of this class, in comparison with other basis functions, that provides an admissible error of approximation with its minimum depth.

Duringthe creation of orthogonal models of correlative spectral characteristics some algorithms of an assessment of coefficients of expansionwere selected, the basic of which are: approximate [2], spectral and analytical [3], analytics-numerical approach [4]. Each of these approaches has merits and demerits.

The advantages of orthogonal models creation with the help of the approximate approach are [2]:

1) abbreviation of storable datavolume;
2) the given algorithms and the structure of model parametersdetermination;
3) visualization and compactness of the received analytical expression, ease of visualization;
4) thepossibility of analytical expression usagefor further analytical researches and conversions for the purpose of obtaining the generalized probable characteristics.

As a disadvantage we can mark the impossibility of a row with required accuracy and arbitrary number of members creation owing to computing errors.

The advantages of the spectral and analytical method are [3]:

1) lowering of time expenditure in case of an assessment of orthogonal rowsexpansion and creation coefficients;
2) reduction of the volume of computing operations in case of an assessment of orthogonal rowsexpansion and creation coefficients.

The disadvantage is the necessity of carrying out operations with the estimates assuming existence of errors, including accidental since coefficients of expansion can't be calculated precisely, especially in case of creation of models of random functions (estimates of correlative and spectral characteristics).

The advantages of analytical approach are [4]:

1) lowering of time and resource expenditure on receiving the end result;
2) increasing of accuracy of an assessment of orthogonal rowscorrelative spectral characteristics.

It is possible to refer to a disadvantage the impossibility to use some orthogonal bases as mathematical apparatus due to the lack of their analytical representation.

Considering merits and demerits of these methods, the development of approximate approach to orthogonal models creation by adding of the new Bessel orthogonal base in the list of the functions which are already used in the approximate analysis of accidental processes is consideredin this article.

Considering the situation described above, we will carry out comparing of algorithms of an assessment of coefficients of expansion in case of application of numerical approach in Laguerre, Legendre, Dirichlet bases; analytics-numerical approach in Laguerre, Jacobi bases, numerical approach in Besselbase.

As an example we will consider the task of creation of the CF model of ideal band noise:

$$f(\tau)=\frac{\sin(\Delta\omega_e\tau)}{\Delta\omega_e\tau}\cdot\cos(\omega_0\tau). \qquad (1)$$

Let's construct the CF (1) model using the selected approaches to an assessment of correlative spectral characteristics in different orthogonal bases for $\Delta\omega_e=0.5,\omega_0=5$ with the following data: sampling interval is $\Delta\tau=0.09$, number of ordinates CF is $N=300$, number of members of expansion of a row is $m=150$.

Parameter values of scale and value of an error of the CF model creation (1) are given in table 1

$$\delta=\Delta\Big/\int_0^{\infty}\big(f(t)\big)^2\cdot\mu\big(\tau,\gamma\big)dt$$

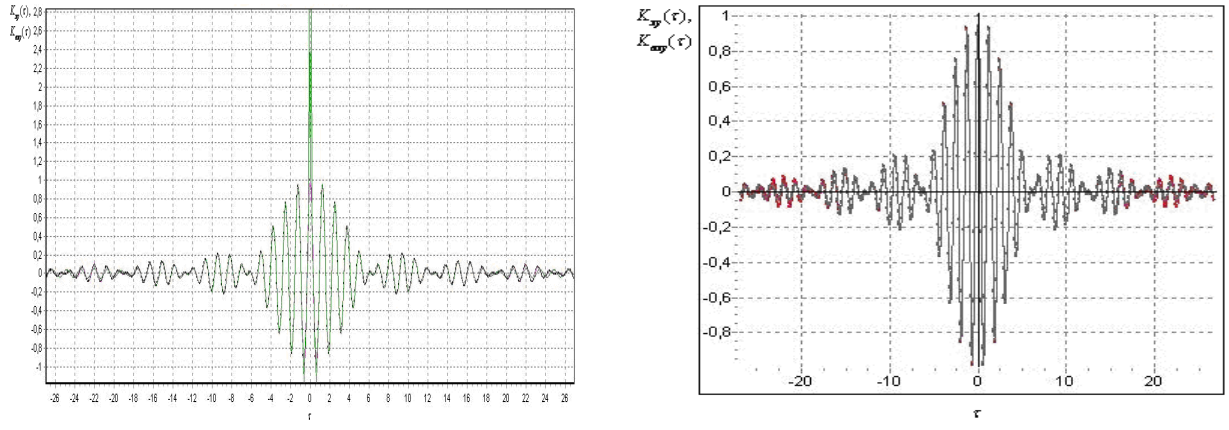
.

In the table we can see that the best result of approximation is received in Besselorthogonal base. The most closest result is received in Laguerre orthogonal base using numerical and analytical approach.

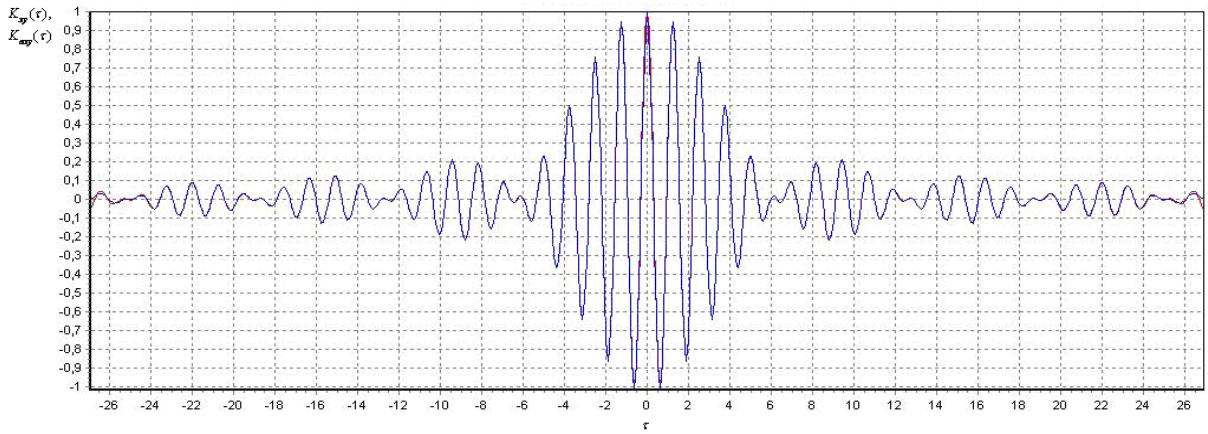
In the figure 1 graphic interpretation of the results of the CF (1) model creation in different orthogonal bases is provided in case of application of different techniques of creation. From the figure it is visible that on a graphics of results of approximation in base of Bessel there is no "burst" in a zero point, and also more exact approximation of the initial CF on all interval of its existence is watched that, in particular, is noticeable on "tails".

Table 1 – The quantitative assessment of results of creation of the CF (1) model using different approaches to an assessment of correlative spectral characteristics in different orthogonal bases

Orthogonal base and approach type	Scaleparametervalue γ	Approximationerror δ
Bessel, numerical	0,029	0,04867
Laguerre, numerical	0,897	0,20476
Legendre, numerical	0,003	0,22425
Dirichlet, numerical	0,006	0,23729
Laguerre, analytics-numerical	4,444	0,06852
Legendre, analytics-numerical	0,015	0,09338
Jacobi(-0,5;0), analytics-numerical	0,015	0,09356
Jacobi(0,5;0), analytics-numerical	0,015	0,09329
Jacobi(1;0), analytics-numerical	0,029	0,09328
Jacobi(2;0), analytics-numerical	0,015	0,09336
Sonin-Laguerre(1;1), analytics-numerical	4,444	0,2003
Sonin-Laguerre(2;1), analytics-numerical	4,444	0,3514



a) b)



c)

Fig. 1. Type of the CF models: a) in Laguerre orthogonal base in case of numerical approach; b) in Laguerre orthogonal base in case of analytics-numericalapproach; c) in Bessel orthogonal base in case of numerical approach

Further we will consider the task of the CF model (2) creation:

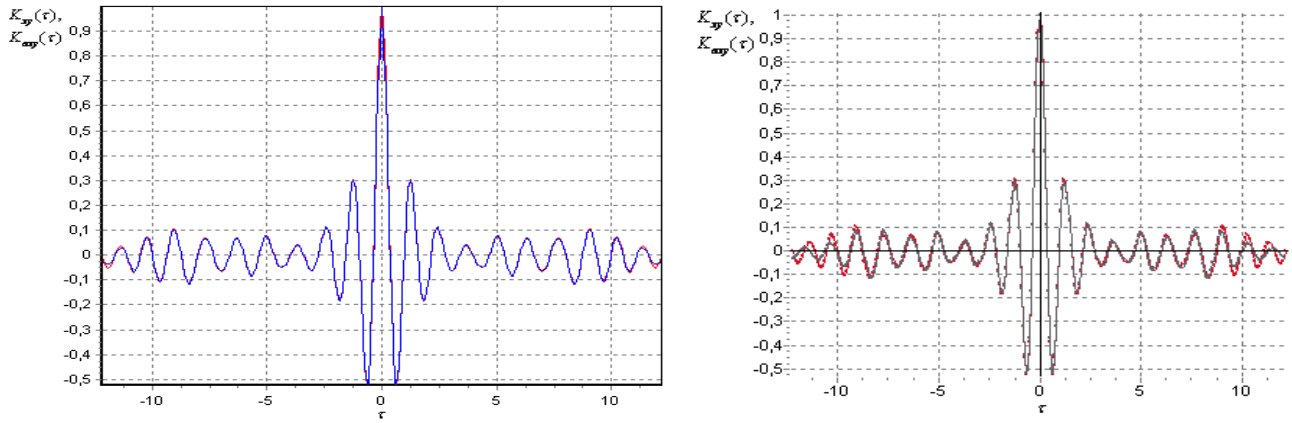
$$f(\tau) = e^{-\alpha|\tau|} \cdot \cos(\omega_0 \tau) \qquad (2)$$

using the selected approaches with a small depth of approximation for $\omega_0/\alpha = 5$ with the following data: sampling intervalis $\Delta\tau = 0{,}08165$, number of ordinates CFis $N = 150$, number of members of expansion of a row is $m = 71$.

The model creation we will carry out with the use of algorithms estimates of coefficients of expansion in case of application of numerical approach in Besselbase and analytics-numerical approach in Laguerre bases which showed the best results in the previous experiment.

In a figure 2 graphic interpretation of the CF (2) model creation results in orthogonal base of Bessel with parameters is provided $\gamma = 0{,}0708$ and $m = 71$ in case of application of numerical algorithm (approximation error $\delta = 0{,}0762$) and in Laguerre orthogonal base with parameters $\gamma = 4{,}899$ and $m = 71$ in case of application of numerical and analytical algorithm (approximation error $\delta = 0{,}1115$).

The best result of approximation on the "relative error of approximation" parameter is received in Bessel orthogonal base.



a) b)

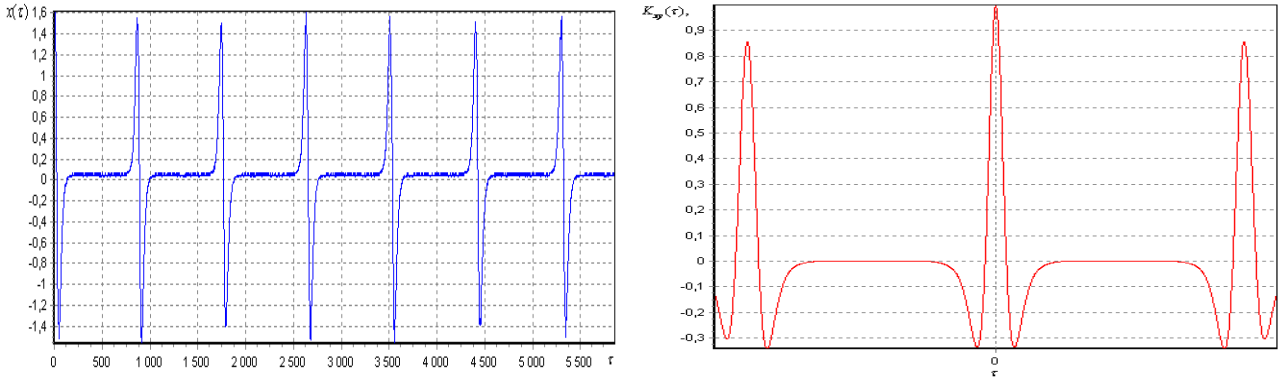
Fig. 2. Type of the CF models: a) in Besselorthogonal base in case of numerical approach, an approximation error $\delta = 0{,}0762$; b) in Laguerre orthogonal base in case of analytics-numericalapproach, an approximation error $\delta = 0{,}1115$

Application of Besselorthogonal functions as basis in case of orthogonal models creation provides satisfaction of the given accuracy of approximation not only for described above CFclass. It is connected to that the formula which is setting Besselorthogonal functions, includes the scale parameter the change of which can change their properties noticeably. Scale parameter in case of Besselorthogonal functions is included even into expression for weight function that allows to coordinate always practically the form of the weighed orthogonal functions with the form of CF arriving on processing.

As the confirming example, we will give the results of creation of the CF model of the signal given on a figure 3 with number of ordinates N=1000 and number of members of expansion of a row m=500.

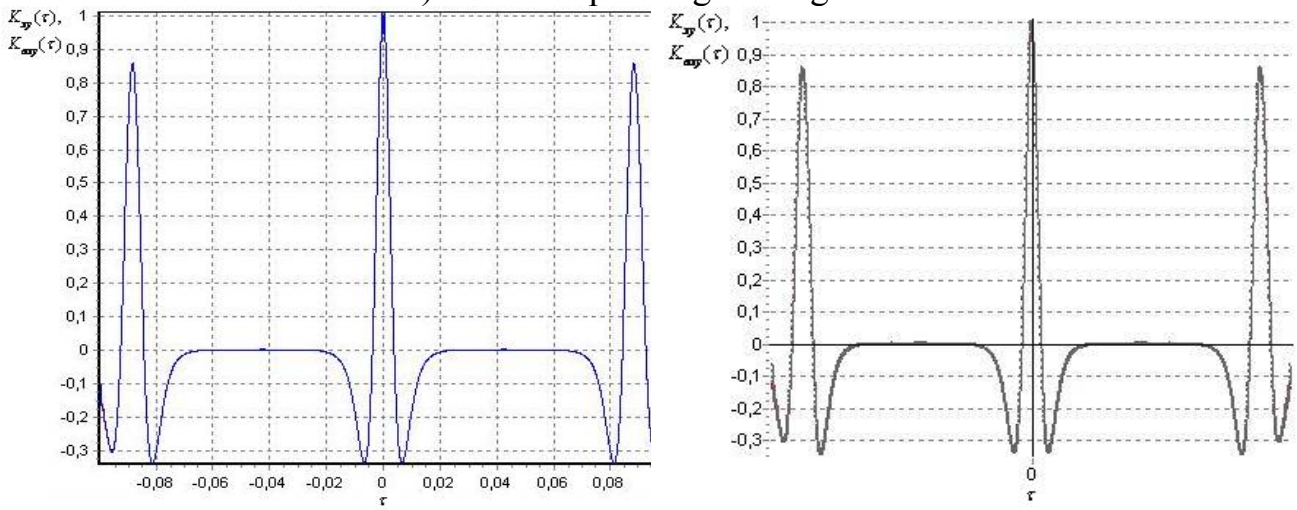
In the figure 4 models of this CF are given in Besselorthogonal base with parameters $\gamma = 7,9840$ and $m = 500$ in case of numerical algorithm (approximation error $\delta = 0,0139$) and in Laguerre orthogonal base with parameters $\gamma = 4000$ and $m = 500$ in case of analytics-numericalalgorithm (approximation error $\delta = 0,0147$).

The best result of approximation on the "relative error of approximation" parameter is received in Besselorthogonal base.



a) b)

Fig. 3. Type of analysable characteristics: a) input signal;
b) CF corresponding to a signal.



а) б)

Fig. 4. Type of the CF models: a) in orthogonal base of Bessel in case of numerical approach, an approximation error; b) in Laguerre orthogonal base in case of analytics-numericalapproach, an approximation error $\delta = 0,0147$

References

1. Solovyova Y.V. Methods, algorithms and complex of programs of the approximate - correlative spectrum analysis in orthogonal base of the Bessel: Dis. ... candidate of technical Sciences: 05.13.18: defended 27.06.2013: approved 21.10.2013. –Samara, 2013. – 116 p.

2. Prokhorov S.A. Approximate analysis of accidental processes /S.A. Prokhorov-the second edition, processed and added. –Samara: SSC RAS, 2001. – 380 p.

3. Dedus F.F. The generalized spectral and analytical method of processing of information arrays. Tasks of the analysis of images and image identification / F.F. Dedus, S.A. Makhorty, M.N. Ustinin, A.F. Dedus. –M.:Mashinostroenie, 1999. – 357 p.

4. Prokhorov S.A. Analytics-numerical approach to computation of integrals in case of creation of orthogonal models / S.A. Prokhorov, I.M. Kulikovskih // Vestnik SSTU Series of physical-mathematical science, 2009. – №2(19). – P.140-146.

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REVIEW ON B. SOUCEK
"Better Life and Business: Cell, Brain, Mind and Sex Universal Laws, Bentham Science Publishers: 2013, 214 p., eISBN: 978-1-60805-494-7"

The reviewed book "Better Life and Business: Cell, Brain, Mind and Sex Universal Laws" is written for the research in the technical, biological, and social systems. The major goal of the book is to establish a new discipline BRAINLIFE BIZ that helps to develop computer models for human and animal behavior.The book contains the significant results in the area of neuroscience and machine learning in general, which will enable to solve the problems of practical importance, for the most part, in the area of big data analysis.

The book contains 30 laws and 100 equations, which describe the processes in different systems: real-time data, acquisition systems, control systems, and transaction processing systems of the brain range. Soucek has introduced the concepts of MARKETBIZ and LIFEBIZ, which describe our behavior in business and in life very realistic and in great depth. Afterwards, to confirm his theory and mathematical models, the author carried out a lot of experiments with the animals and human.

Using principles of self-organizing makes it possible to establish new understanding of neuroscience as the science about behavior and state.It is noteworthy to mention that his name SOUCEK used as an acronym will make a list of elements of self-organizing systems: Self-Organizing of Understanding, Consciousness, Emotions and Knowledge.

Soucek worked as a professor of the Computer and Brain Networks at the Universities of Zagreb, New York and Arizona as well as a researcher and consultant for the NASA, IBM, and Siemens, Schering, Brookhaven National Laboratory, Institute Rudjer Boskovic. As a result he published more than 10 books about mini and microprocessors, computers and applications in Neurobiology and Behaviour, sixth generation computer technologies and so on.Professors and students in different countries have been using ideas from Soucek books published in English and translated into Croatian, Russian and Japanese.

I have had an excellent opportunity to work under professor Soucek's supervision for one year at Zagreb University, Rudjer Boskovic Institute and inter-university centre of postgraduate studies at Dubrovnik at 1979-1980. Furthermore, Soucek ideas