In the canonical expansion (26) the random sequence $\{X'\}$ is presented in the investigated range of points $t_i, i=\overline{1,I}$ with the help of N arrays $\{U^{(\lambda)}\}, \lambda=\overline{1,N}$ of uncorrelated centered random coefficients $U_i^{(\lambda)},\ i=\overline{1,I}$. The given coefficients contain information about the values $Z^{\lambda}(i),\ \lambda=\overline{1,N},\ i=\overline{1,k}$ and $X^{\lambda}(i),\ \lambda=\overline{1,N},\ i=\overline{k+1,I}$, and coordinate functions $\gamma_{h\nu}^{(\lambda)}(i),\ \lambda,h=\overline{1,N},\ \nu,i=\overline{1,I}$ describe probabilistic connections of the order $\lambda+h$ between sections t_ν and $t_i,\ \nu,i=\overline{1,I}$.

Let us assume that as a result of measurement in the first point of discretization t_1 value $z(1)$ becomes known (additive mixture of unobserved true value $x(1)$ and error $y(1)$). Measurement $z(1)$ concretizes random coefficients $U_1^{(\lambda)},\ \lambda=\overline{1,N}$ for section t_1:

$$u_1^{(\lambda)}=z^{\lambda}(1)-M\left[Z^{\lambda}(1)\right]-\sum_{j=1}^{\lambda-1}u_1^{(j)}\gamma_{\lambda 1}^{(j)}(1),\ \lambda=\overline{1,N}. \qquad \textbf{(34)}$$

Substitution of values (34) in canonical expansion (26) and further application of the operation of mathematical expectation allow to write down the expression for the estimation of future values $x^h(i)$ with the use of a posteriori information $z^l(1),\ 1=\overline{1,N}$ in the following form

$$m_{x/z}^{(1,l)}(h,i)=m_{x/z}^{(1,l-1)}(h,i)+\left(z^l(1)-m_{x/z}^{(1,l-1)}(l,1)\right)\gamma_{h1}^{(l)}(i) \qquad \textbf{(35)}$$

where $m_{x/z}^{(1,l)}(h,i)$ is optimal (in mean-square sense) estimation of value $x^h(i)$ provided that for the prognosis values $z^j(1),\ \mathrm{j}=\overline{1,l}$ are used.

Measurement $z(2)$ leads to the fixation of random coefficients $u_2^{(\lambda)},\ \lambda=\overline{1,N}$ for t_2:

$$u_2^{(\lambda)}=z^{\lambda}(2)-M\left[Z^{\lambda}(2)\right]-\sum_{j=1}^{N}u_1^{(j)}\gamma_{\lambda 1}^{(j)}(2)-\sum_{j=1}^{\lambda-1}u_2^{(j)}\gamma_{\lambda 2}^{(j)}(2),\ \lambda=\overline{1,N}. \qquad \textbf{(36)}$$

Use of the values of random coefficients (36) allows to obtain prognosis algorithm taking into consideration $z^l(1), z^l(2)\ 1=\overline{1,N}$:

$$m_{x/z}^{(2,l)}(h,i)=\begin{cases} m_{x/z}^{(2,l-1)}(h,i)+\left(z^l(2)-m_{x/z}^{(2,l-1)}(l,2)\right)\gamma_{h2}^{(l)}(i),\ l\neq 1; \\ m_{x/z}^{(1,N)}(h,i)+\left(z(2)-m_{x/z}^{(1,N)}(1,2)\right)\gamma_{h2}^{(1)}(i),\ l=1. \end{cases} \qquad \textbf{(37)}$$

For random quantity of measurements $z(\mu),\ \mu=\overline{1,I}$ the algorithm of optimal extrapolation takes on form:

$$m_{x/z}^{(\mu,l)}(h,i)=\begin{cases} M\left[X^h(i)\right],\ \mu=0; \\ m_{x/z}^{(\mu,l-1)}(h,i)+\left(z^l(\mu)-m_{x/z}^{(\mu,l-1)}(l,\mu)\right)\gamma_{h\mu}^{(l)}(i),\ l\neq 1; \\ m_{x/z}^{(\mu-1,N)}(h,i)+\left(z^l(\mu)-m_{x/z}^{(\mu-1,N)}(l,\mu)\right)\gamma_{h\mu}^{(l)}(i),\ l=1. \end{cases} \quad \textbf{(38)}$$

Expression $m_{x/z}^{(\mu,l)}(h,i)=M\left[X^h(i)/z^\nu(j),\ j=\overline{1,\mu-1},\ \nu=\overline{1,N};\ z^\nu(\mu)\right.$, for $h=1,\ l=N,\ \ \mu=k$ is unbiased optimal estimation $m_{x/z}^{(k,N-1)}(1,i)$ of future value $x(i),\ i=\overline{k+1,I}$ provided that for the calculation of given estimation values $z^\nu(j),\ \nu=\overline{1,N},\ j=\overline{1,k}$ are used that is the results of the measurements of sequence $\{X'\}$ in points $t_j,\ j=\overline{1,k}$ are known.

In Fig. 1 the diagram is presented that reflects peculiarities of functioning of the method of prognosis (38).
Mean-square error of extrapolation with the help of method (39) is determined by the expression:

$$M\left[\left\{X\left(i/z^\nu(j),\ \nu=1,\overline{N},j=\overline{1,k}\right)-m_{x/z}^{(k,N)}(1,i)\right\}^2\right]=M\left[X^2(i)\right]- \\ -M^2\left[X(i)\right]-\sum_{j=1}^{k}\sum_{\nu=1}^{N}D_\nu(j)\left(\gamma_{1j}^{(\nu)}(i)\right)^2,\ i=\overline{k+1,I}. \quad \textbf{(39)}$$

6 Conclusion

In nowadays, the prognostication of the current state of complex computer systems, especially, for the class of critical applications, is an important and actual problem for providing high functioning reliability of the various control objects and decision-making systems. The proposed approach, based on the mathematical formalization of the parametrical changes of computer systems using nonlinear canonic models of the random sequences, allows to take into account the stochastic properties of investigated computer systems. Exhaustive solutions of the prognostication problems are obtained by authors with the aim of the evaluation of the computer system state and analysis of its further operational capability in the situations with different volume of a priori and a posteriori information or with various levels of information uncertainty. Synthesized prognostication methods as well as assumed, as their basis canonical expansions do not impose any significant limitations on random sequences

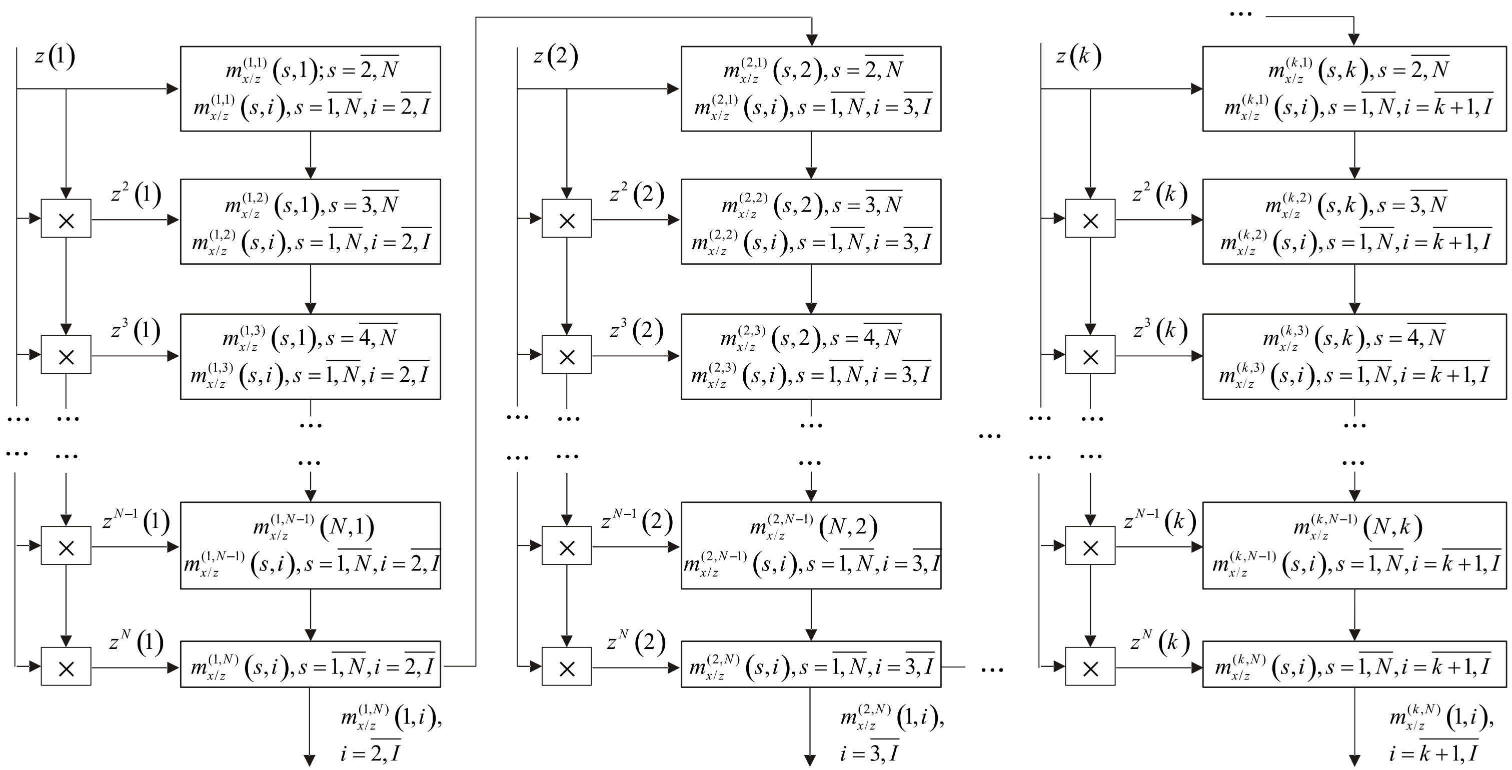

Fig. 1. Diagram of the prognosis of a noise random sequence with the help of extrapolator (38)

of the change of the values of controlled parameters including linearity, stationarity, Markov behavior, monotoneness, etc. Suggested mathematical expressions for the determination of mean-square error of extrapolation allow to make a decision about the choice of the most appropriate method from the totality of the introduced ones for the solution of the prognostication problem of computer system with prescribed accuracy. The specific diagram, presented in the paper, reflects the peculiarities of the synthesized prognostication methods. Proposed methods are fairly simple in computing aspects and may be applied for solving computer system prognostication tasks in real time taking into account that all parameters of the prognostication models can be defined previously.

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