ANALYSIS THE SIGNIFICANCE OF RELIABLE EXPERIMENTALLY DETERMINED DISTRIBUTION LAWS

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Abstract: Experimental data collected drift (random size) of the law affecting real experimental data set, so it is not the only manifestation of the set of theoretical parameters. The same law theoretically true distribution may materialize through an infinity of sets of experimental data due random factors influence. The paper presents practical ways of determining confidence intervals using Monte Carlo method. The central issue of how the analysis is to determine the parameters found empirical distribution so as accurately to model the system state.

Keywords: Gaussian, circulation system, analysis methods.

1. Structural analysis

The systems are equipped with the same gearing, and the table – with a mechanical power take off and a gear box (T) for TF, MR or P. Below we will note the structural schemes for the rotating system (SR) and for the circulation system (SC), respectively. For the centralised or group operating mode the main operating systems (SM, SR and SC) are operated by the same engine or group of engines or pumps P1 and P2, [1].

The total reliability function for this operating mode is calculated using the features of structural analysis methods [2].

The total reliability function in G1 case:

\[ R_{G1} = R_m \cdot R_t \cdot \left[ 1 - \left( 1 - R_{tf-c-r} \right) \left( 1 - R_{pf-p} \right) \right] \cdot R_{gf} \]  

where:

\[ R_{tf-c-r} = R_{tf} \cdot \left[ 1 - (1 - R_c) (1 - R_{cv} \cdot R_{mr} \cdot R_t) \right] \]

\[ R_{pf-p} = \left[ 1 - (1 - R_{pf1} \cdot R_p) (1 - R_{pf2} \cdot R_p) \right] \]
*Rm* the reliability function of the group of *n* engines
*Rch* – the reliability function of swivel casing

There is also a second variant for the group operating mode, G2, where one of the pumps has its own group of engines and gearing, and for MR the power take off is connected either to TF or directly to T1, as shown in the chart below:

The total reliability function in this case is:

\[
R_{G2} = [1 - (1 - R_i) \cdot (1 - R_{II})] \cdot R_{gf}
\]  

(2)

where:

\[
R_i = Rm_{1,2} \cdot Rt \cdot [1 - (1 - R_{tf-c-r}) \cdot (1 - Rpf1 \cdot Rp1)]
\]

\[
R_{II} = Rm_{3} \cdot Rt_{2} \cdot Rpf_{2} \cdot Rp_{2}
\]

In order to carry out some purely reliability comparative analyses of finding the optimal operating mode, the designer may choose his own values for simulation so that he could decide which of the operating modes leads to a convenient value of reliability according to the number of elements taken into account and their grouping mode.

2. Distribution functions use.

Weibull distribution function is adaptive technology equipment during its life time the failures are mainly due to wear and or aging phenomena [1],[4].

\[
R(\tau) = 1 - e^{-\left(\frac{\tau - \gamma}{\eta}\right)^\beta}, \quad \text{the values of variables are known. (3)}
\]

\[
\text{Fig.2. Repartiția Weibull}
\]

Gaussian normal distribution function or normal law is adaptable to different technical systems in which failures are due to many factors, which usually causes wear and tear phenomena of materials [1],[4].

\[
R(\tau) = \frac{1}{\sigma \sqrt{2\pi}} \int_{-\infty}^{\tau} \exp \left[ -\frac{1}{2} \cdot \left(\frac{\tau - \mu}{\sigma}\right)^2 \right] d\tau
\]

(4)
3. Simulations by models

The system functions (R) contained by the models described above can be continuous or discrete or signal functions (known reliability functions or chance number generating functions following various distributions simulated by means of the programming mode (MathCad)) and will replace block functions (R) within computer-assisted simulation.

The structural models thus obtained can allow us to carry out simulations useful to the design of safe and efficient systems, enhancing their performances.

This software package provides the user with a complete series of probability distributions with continuous or discrete variation and the chance number generators distributed according to the corresponding partition law [3].

The partition law WEIBULL adapts to the reliability study of technological plants during their running, when failures occur mainly because of the plant’s run out and/or ageing. The NORMAL partition law adapts to the various technical systems whose failures occur because of a great number of factors, which generally lead to materials’ wear and breakage.

<table>
<thead>
<tr>
<th>Number simulations</th>
<th>Reliability total values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group1</td>
</tr>
<tr>
<td>100</td>
<td>0.858</td>
</tr>
<tr>
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<td>0.856</td>
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<tr>
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<tr>
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<td>0.846</td>
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</tbody>
</table>

For the estimation of the probability of failure by frequency of INTO occurrence the sufficiently large number of computer simulations should be performed as Gauss and Weibull trials. Each trial consists of the generations of the random realizations all input quantities, performing the deterministic analysis of the values R as the functions of these realizations.

Analysis of accuracy must be performed using the asymptotic distribution of the obtained estimate not the quantity of gives probability. Then the average of these values from all trial is calculated with MathCad program model. The average this method its similarity and higher effectiveness it comparison which the estimation of the random probability frequency (rnorm and rweibull).
4. Conclusions

The author proposes that the method should be also applied for the other operating modes of drilling plants which were mentioned taking into account their characteristics. In are presented three structural models (G1, G2), whose graphs are displayed in descending order of reliability analysis and numerical simulation for a drilling plant.

The procedure of calculations is as follows: at which realisation of variable R is generated in accordance with its probability density function (this function MathCad is supposed to be know) and the value of the probability distribution function of quantity R is determined (this distribution is generated at MathCad system).

The average this method it is similarity and higher effectiveness it comparison which the estimation of the probability frequency. Analysis of accuracy must be performed using the asymptotic distribution of the obtained estimate not the quantity of gives probability.

The main contribution this article makes is the introduction of structural models in the calculation of complex systems’ reliability (drilling plants or production installations).

References