Applying stochastic analysis of experimental data to optimize the bioactive compounds extraction from agro-food industry waste

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Classical statistics are based on the law of large numbers, which calls for many experimental values. In the case of costly experiments with fewer practical values, the results can be questionable as classical statistics offer only one prediction horizon, which is a disadvantage in terms of the credibility of the conclusions. To reduce the uncertainty of complex experimental modeling, it is necessary to apply the stochastic analysis of the experimental data, the most used methods in this regard, using the bootstrap algorithms [1]. Bootstrap techniques consist of reshaping the experimental discrete series (re-sampling is another name for bootstrap) based on stochastic distribution laws, so not the usual classical ones (normal, Weibull, etc.); the most used are Markov processes, the Monte Carlo method and others [2]. Bootstrap algorithms consider each sample to be irreptable, which is true, since it is known that two absolutely identical results can never be obtained.

Experimental research focused on 6 products (bioactive compounds extracts from forest fruits and agro-food industry waste) and a maximum of 9 experimental parameters determined. The purpose of applying the stochastic analysis was to establish predictive elements, which allow good data interpolation, ensure the greatest credibility of the experimental results, including the values of factors of influence on the extraction process (concentration of ethyl alcohol, hydromodule, duration and temperature extraction, pulse number, field intensity, voltage) not found experimentally, as well as the determination of the most pronounced and the weakest interdependences of the measured parameters.

The principle of the bootstrap technique is the following, with an example for a certain parameter P in the $P1$-$P9$ range. We know from experimentation the finite discrete series, which is a vector of n values $P = \{P_1, P_2, ..., P_n\}$, with the unknown distribution function F and it is desired to estimate $Q^* = S(P)$ of the set of characteristic parameters $Q = f(F)$ related to the set of values of some parameter P. Applying this principle requires two calculation steps: 1. The determination of B samples with the same number of values and with the same specification (mean, standard deviation, median, dispersion, etc.) as those of the experimental series, subject to the unknown distribution law F: $P_i^* = \{P_{1i}^*, P_{2i}^*, ..., P_{ni}^*\}; i = 1, 2, ..., B$. 2. The estimation of the set of characteristic parameters for each sample obtained by sampling: $Q_i^* = S(P_i^*)$; $i = 1, 2, ..., B$.

Stochastic analysis of experimental data allowed: performing prediction with a higher prediction horizon than that provided by classic statistics, which gives a high veracity of results; obtaining a lot of reliable data, complementary to the experimental ones, which are usually of low volume; obtaining credible results in situations commonly encountered in practice, namely when experimental data is not subject to the distribution laws known in classical statistics.

Following the stochastic analysis of the experimental data, the following conclusions were drawn:

– the data obtained by applying bootstrap algorithms allow prediction with a high prediction horizon;

– the application of the booster algorithms provides acceptable results and in the cases of few experimental data, frequent situations in practice;

– the boostrap algorithm offers a flexible stochastic analysis method, since it allows the imposition of any specification on the experimental data.

Bibliography

[1] M. R. Chernick, *Bootstrap methods: A predictioner's guide*, John Wiley and Sons, New York (1999).

[2] C. Z. Mooney and R. D. Duval, *Bootstrapping: A nonparametric approach to statistical inference*, Newbury, Sage Publications (1993).

Numerical analysis of the dynamic loading of elastic-plastic buried structures

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Use of computer technology allows solving of the most complex applied problems, such as dynamic loading of a solid deformable body under the influence of a wide range of external loads (seismic, explosive and others). The study of seismic and explosive impact is based on a series of approximations and models, related to the environment's structure and distribution of the seismic impulse and shock waves in this environment.

For Moldova as priority challenges, we consider environment monitoring and forecasting of changes of environmental parameters, seismic data collection and processing, modelling of seismic waves influence on dangerous constructions.

The problem of computer estimation of operational condition of potentially dangerous objects is very actual for various regions. The potentially dangerous objects are objects where used, stored, transported or destroyed flammable, explosive and toxic substances (oil depots, gas stations, storages of fertilizers, ammunition depots).

Their damage or destruction in the event of seismic impact (or other force majeure) may lead to environmental disasters. Full-scale physical tests in the industry are difficult or expensive; therefore the significance of mathematical modelling increases. The modern computational capabilities allow solving of the above-menti-

oned problems with using numerical algorithms based on finding solutions of complex mathematical physics equations, to take for model creation a lot of information about objects, which interact with each other and with the environment in the model framework.

The possibilities of analytical methods and application of solutions based on physical experiments are quite limited. Researchers are trying to create to precise mathematical models, numerical algorithms and data analysis systems to obtain reliable numerical solutions for more efficient design of constructions. The implementation of these solutions is a complex task because of their large and number of parameters.

For a correct description of the elastic-plastic behaviour of constructions realistic equations of state for construction filling materials and explosives is necessary to use. The behaviour of various materials is described within the equation of state in the form of Mie-Gruneisen [1], taking into account a complex stress-strain behavior of substance.

The system of governing equations describes the motion of elasto-plastic medium under a shock and blast loading. Equations are written in Lagrange coordinates in a two-dimensional setting. In