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REDUCING THE NUMBER OF RUNS IN EXPERIMENTAL RESEARCH USING SMART DESIGNS OF EXPERIMENT

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In many areas of science, experimental research serves as the main source of obtaining the knowledge and information. If it is necessary to limit cost or time of experiment, one can use special techniques offered by the theory of experiment, also known as the design of experiment methodology (DoE). Depending on the goal of research, various types of experimental designs can be used. The application of the experimental designs with special techniques for the analysis of experiment's results can often facilitate reducing the size of the experiment (number of runs, observations, etc.) and obtaining relevant information from the research, without reducing its quality.

This article presents results of computer simulation made to evaluate how the quality of the smart designs of experiment depends on the methods of generating. The key feature of smart designs of experiment is a possibility to adapt the design to the conditions of conducted experiment by setting the number of designs units, inputs and inputs levels. To study how the number of the smart designs of experiment units affects the quality of the information to be obtained in experimental research which is conducted on the basis of the analyzed designs, a computer simulation was performed, where a real research object was simulated by a special testing function – Rosenbrock's Function. The quality of smart designs is evaluated by comparing the known values of special testing functions simulating the real research object to approximated values predicted by neural networks trained with the sets based on smart designs of experiment.

The simulation shows that it is possible to reduce the number of experiments (observations, runs) performed in the experimental research. The application of smart designs of experiment could facilitate their reduction, even to 25-50% of the number of full design's units. It could sometimes mean reducing the time or the cost of research significantly. The simulation was conducted for the 3-inputs smart designs. However, the procedures of the generating and analysing of smart designs are universal for all designs' characteristics, so the conclusions should also be true for the cases of another numbers of inputs, levels or design's units, and could be used in a broad area of engineering.

Having compared the two analyzed methods of generating the design's units, the R2-method appears to be more recommended, especially because of Kolmogorov-Smirnov test results and a smaller variation of errors. The same conclusions might be drawn by analyzing the results of the simulation in which the influence of generation methods on the quality of the smart designs of experiment was studied.

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