

RepoSTAR –New Framework for Statistic Runs for Uncertainty and Sensitivity Analysis of a Radioactive Waste Repository Model

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For long-term assessment of the safety of final repositories for radioactive waste the program package RepoTREND is being developed and applied by GRS [1-2]. The statistical framework of RepoTREND is called RepoSTAR. The development of this framework was motivated by a number of practical problems that occurred in the past when performing probabilistic analyses.

RepoTREND requires a high number of input parameters. A probabilistic investigation should give information about the effects of epistemic or aleatory uncertainties on the safety assessment results. These uncertainties, however, correspond to aspects of the physical problem and not to the technical input requirements of the model. It is possible that one physical uncertainty influences several different program input parameters, maybe even belonging to independent computation modules, and it is also possible that one input parameter is influenced by several principally independent physical uncertainties. In the past, such interconnections often required individual, error-prone programming work that had to be changed for each case study.

To avoid this problem, RepoSTAR, unlike former computational approaches, clearly distinguishes between *probabilistic variables*, which refer to the physical problem, and *input parameters*, which refer to the program. Users are free to define the case study, identify relevant physical uncertainties and parameterise them by defining probabilistic variables, regardless of the model input requirements. Only in the second step, the user has to think about how each input parameter is affected by these variables. RepoSTAR provides a simple formula notation, which allows defining nearly any kind of relationship. By evaluating such dependencies during runtime, but outside the calculation code, this concept offers a convenient practical way to perform probabilistic analyses without any need to modify the code.

A probabilistic analysis with RepoTREND and RepoSTAR proceeds as follows:

Once the problem has been defined, the user has to assign a marginal pdf to each probabilistic variable, according to available expert knowledge. Linear statistical dependencies between the variables can be taken into account by defining a correlation matrix. The user can choose between different sampling schemes (random, LHS, quasi-random, (E)FAST, among others) and random number generators.

In a second step, the links between the probabilistic variables and the program input parameters are defined by the user. These can include mathematical functions as well as logical decisions. The mappings are coded using a simple formula notation, which is fed into the program via the data supply tool XENIA. After defining some general data like the number of runs to be executed, the user starts the probabilistic calculation. For each single run, RepoSTAR evaluates the mapping formulas, replaces the input parameter values accordingly and executes the model run. After completion of each single run, RepoSTAR collects the model output of interest. In principle, any time-dependent model output can be chosen. These values are interpolated to a common time grid and written into a specifically formatted file.

When all runs are finished, the user starts the evaluation tool RepoSUN. This tool is specifically designed to work with the output generated by RepoSTAR. It has an own GUI and pro-

vides uncertainty analysis as well as a number of graphical and numerical sensitivity analysis methods (SRRC, PCC, PRCC, Smirnov test, EASI, FAST, EFAST, Sobol, among others).

RepoSUN uses the new SimLab 4 library, which has been developed by JRC and GRS. SimLab 4 contains an interface to the statistical programming language R and can be enabled with low effort to calculate nearly any UA or SA measure. Via SimLab 4, RepoSUN has access to a wide, extendible variety of scripts written in R and is therefore fit for future developments.

The RepoSTAR concept can be applied not only in the context of the processes in the final repositories for the radioactive waste but universally, e. g. for any complex model and any computational code.

References

[1] Becker, D.-A.: RepoSTAR – Ein Codepaket zur Steuerung und Auswertung statistischer Rechenläufe mit dem Programmpaket RepoTREND. Gesellschaft für Anlagen- und Reaktorsicherheit (GRS) gGmbH, GRS-411, BMWi-FKZ 02E10367, Braunschweig, 2016.

[2] Reiche, T.: RepoTREND – Das Programmpaket zur integrierten Langzeitsicherheitsanalyse von Endlagersystemen. Gesellschaft für Anlagen- und Reaktorsicherheit (GRS) gGmbH, GRS-413, BMWi-FKZ 02E770240, Braunschweig, 2016.

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