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AN INTEGRATED SOLUTION FOR DATA FARMING AND KNOWLEDGE DISCOVERY IN SIMULATION DATA: A CASE STUDY OF THE BATTERY SUPPLY OF A VEHICLE MANUFACTURER

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ABSTRACT

The development of logistics concepts, here for supplying an automobile production with batteries, is a major challenge, especially when there are uncertainties. In order to mitigate this, the method of knowledge discovery in simulation data is to be applied here. In order to enable the planners to easily use the method, a tool that can be easily integrated into practical use (SimAssist-4farm) was developed.

1 INTRODUCTION

This paper describes the use of the method of Knowledge Discovery in Simulation Data (Feldkamp et al. 2020) on a logistic problem in the automotive industry. Specifically, a loading and unloading station for the delivery of two different types of batteries by trucks is to be investigated. The trucks are unloaded respectively loaded with empty load carriers using forklifts. Several buffers are accessible for this purpose. The difficulty lies in the fact that the proportion of battery-electric vehicles in total production and thus the amount of batteries required is difficult to forecast. In addition, the two variants of batteries that are installed are delivered separately. Here too, it is difficult to predict which type is required in which proportion. The logistics concept to be developed must take this into account accordingly.

In data farming, a simulation model is used to generate Big Data by applying an extensive experiment design that covers the system behavior as completely as possible. Feldkamp et al. (2020) developed and validated the process of Knowledge Discovery in Simulation Data (KDS), which extends data farming to include data mining methods for data analysis and various tools for interactive data exploration. The methods of data farming and KDS can provide valuable insights, especially for simulation problems of the systems design phase such as the one discussed here, but have so far seen little industrial application due to the unavailability of easy-to-use tools.In this contribution, we give an overview of our solution to this problem by presenting the developed concept of the software solution and the implemented methods using the described case study from the automotive industry. The solution has been developed within the project “Development of an integrated solution for data farming and Knowledge Discovery in Simulation Data” (DaWiS) funded by the German Federal Ministry of Education and Research.

2 TOWARDS AN INTEGRATED SOLUTION FOR DATA FARMING AND KNOWLEDGE DISCOVERY IN SIMULATION DATA

Figure 1 shows the concept of the developed solution. On the left is the DaWiS controller (DC) which is implemented as a class within the simulator. Currently Siemens Plant Simulation and AnyLogic are

supported, but others can easily be added, as the requirements of the DC are explicitly defined. The right-hand side shows the 4farm module, which is implemented as an extension module in the already existing software solution SimAssist (SA). The DC handles the configurations of the simulation model necessary for data farming. In this case, a Siemens Plant Simulation model represented the described logistic system.

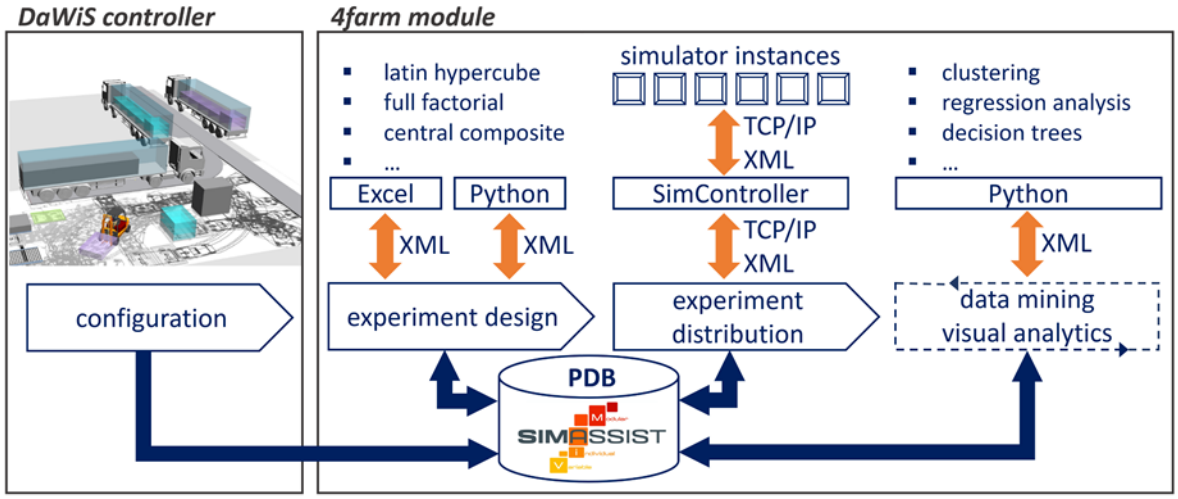

Figure 1: Conceptualization of the integrated solution for data farming and knowledge discovery.

Furthermore the DC creates and provides the project database (PDB) to SA. The PDB contains all the information and data generated during the workflow and allows the 4farm module flexible access to it. In the next step, various experiment designs can be selected and parameterized. The computations of these are done in Python or through Excel. Computations of the knowledge discovery methods are also performed in an independent Python process. Further the experiment distribution is done by sending the experiment plan via a TCP/IP interface to the SimController (SC). The SC handles the queue and distributes the experiments to individual simulator instances on (cloud-based) servers, which use the DC for parameterization and logging. These report their status and the results back to the PDB. The interfaces and functions in all workflow steps were implemented with a high degree of modularity to allow an easy expansion with new methods as well with an easy to understand documentation for the inexperienced user. To achieve a standardized data exchange between the components, the XML data format is used.

3 SUMMARY

The use of the SimAssist - 4 farm tool enabled the planners to quickly deploy the KDS method to develop a good logistics concept with moderate training effort. The corresponding insights about the simulation model and therefore the overall results will be presented at WSC 2021.

ACKNOWLEDGMENTS

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REFERENCES

Feldkamp, N., S. Bergmann, and S. Strassburger. 2020. "Knowledge Discovery in Simulation Data". *ACM Transactions on Modeling and Computer Simulation* 30(4):1–25.