Automated Machine Learning for Supporting Vehicle Design: The Case of a Global Sensitivity Matrix

Jana Büttner
Dr. Ing. h.c. F. Porsche AG, Weissach, D

Thomas Bäck
Leiden University, Leiden, NL and divis intelligent solutions GmbH, Dortmund, D

Many different engineering disciplines are involved in a vehicle development process. The disciplines must cooperate closely as their actions influence each other.

In this presentation, we show how the interactions between disciplines and design variables can be learned through machine learning approaches, resulting in a global sensitivity matrix. The global sensitivity matrix shows the couplings of disciplines via the design variables.

Based on simulation and/or experimental data, automated machine learning algorithms are applied to learn the relationship between design variables and discipline specific requirement values. The generated approximation models (metamodels) can be made available to all departments via a data management server, for example. It is now possible for all departments to carry out global investigations without requiring the corresponding simulation or experimental know-how of the respective departments, since all the necessary information can henceforth be taken from the metamodels.

In the daily development process, an engineer can now identify sensitive variables and the degree and direction of influence on all multi-disciplinary objectives. She gets this information in real-time and with a local confidence as a measurement of reliability. With this information, the engineer can decide which variables are useful to change in order to fulfill her own requirements without negatively influencing other disciplines. If it is not possible to change only discipline-related sensitive variables, the engineer is informed about the affected disciplines and therefore the coordination paths before making any variable changes. She can make suggestions to the affected disciplines for a new design space, in which all interdisciplinary requirements are met. Furthermore, this approach enables engineers to jointly plan and execute a multidisciplinary optimization project.