Application of CAE/ML technique for multifunctional trade-off study between mass and performances

Yoshio Fujita [1]   Shigeki Kojima [1]   Kosho Kawahara [1]

1) TOYOTA MOTOR CORPORATION
1, Toyota-cho, Toyota, Aichi, 471-8572, Japan

Multifunctional trade-off solution about layout of vehicle body structure in the vehicle planning phase are required in order to be shorten development period and reduce the development cost. On the other hand, in the vehicle planning phase, it is difficult to create CAD data for vehicle planning which is changed frequently and to rapidly evaluate the performance by using FE simulation.

The purpose of this paper is to propose the CAE / Machine Learning (ML) technique for solution of multifunctional trade-off between mass and performances. Figure 1 shows creation flow of performance map which is drawn the trade-off relations of two parameters. Large number of parametric FE simulation data was used as training data and ML models were built by them.

Figure 2 shows three body structures in changing the design parameters of both position of roof and distance between the roof rails.

Figure 3 shows the performance maps about two design parameters of Figure 2. In the body structure A, static torsional stiffness and the roof strength were improved from those in the initial body structure, but the vehicle curb mass increased. In the body structure B, while the vehicle curb mass was lower than that in the initial body structure, static torsional stiffness and roof strength decreased. As described above, the multifunctional trade-off relation between mass and performances was able to be demonstrated by using performance maps.
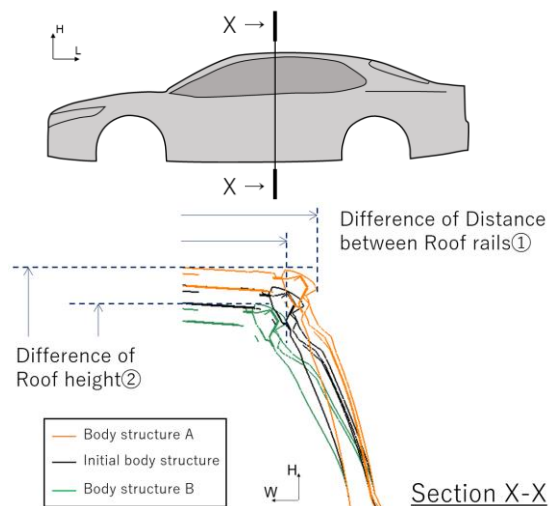

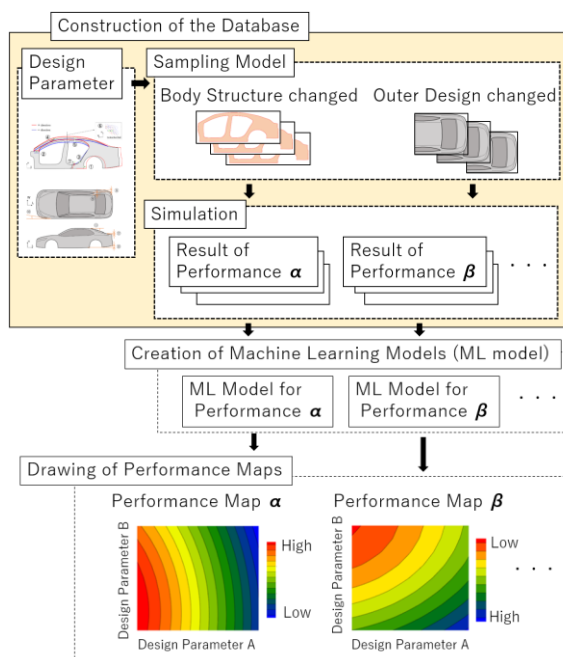Fig.2 Body structures after parameter changed

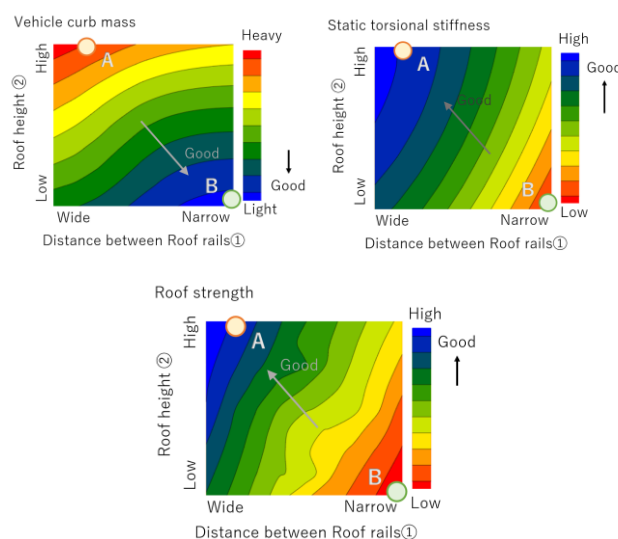Fig.1 Creation flow of performance map

Fig.3 Performance map of Vehicle curb mass, Static torsional stiffness and Roof strength