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Clarification of Impact Load Transfer Path using Graph Structured Analysis

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Automobiles are required to reduce carbon dioxide emissions, improve fuel efficiency for energy saving, and have high safety performance that protects human lives in the event of a impact.

Conventionally, only the impact bar and hinge of the door transmit the load to the vehicle body frame in a side impact. Therefore, we considered using the door panel to disperse the transmitted load to the vehicle body frame.

To utilize the door panel for load distribution, the load transmitted by the contact between the door panel and the vehicle body frame must be controlled. The contact between the door panel and the vehicle body frame is affected by the deformation behavior that fluctuates according to the strength distribution of the door panel. Therefore, it is necessary to understand the load transmission phenomenon when deriving the door panel structure having the load distribution function. The door panel was divided into 21 parts, and the strength distribution was examined (Fig. 1).

To elucidate the load transfer phenomenon at the time of impact, we used a Graph Structured Analysis method that can analyze the parent-child relationship between nonlinear time-series data. Graph structured analysis learns the structure of Bayesian networks based on Bayesian Dirichlet equivalence uniform score maximization after categorizing them into multilevel systems for a set of multiple factors such as time series data that have continuous quantities. At the same time, it is an analysis method that can automatically extract the hierarchical structure of factors that reach the variable of interest.

As a result of Graph Structured Analysis using the floor cross-sectional load as an output, it was found that there is a parent-child relationship in which the side sill part of the front door is the parent and the contact load between the rear door and the rear body of the vehicle body frame is the child. This can be interpreted that the strength characteristics of the side sill part of the front door panel affect the contact load between the rear door panel and the vehicle body frame, and new findings were obtained (Fig. 2).

From the consideration of the impact analysis results, it was found that the contact between the front and rear parts of the side sill part of the front door panel and the vehicle body frame is the key point for load transmission to the floor part (Fig. 3).

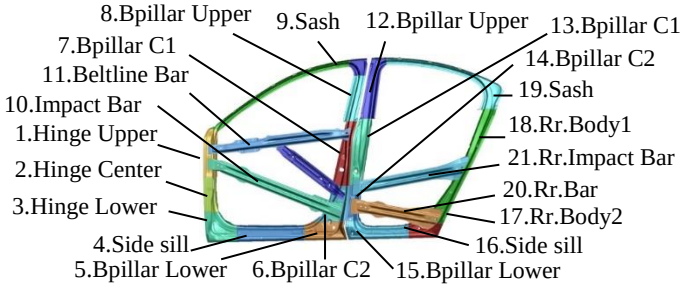

Fig.1 Door panel parts of input factors

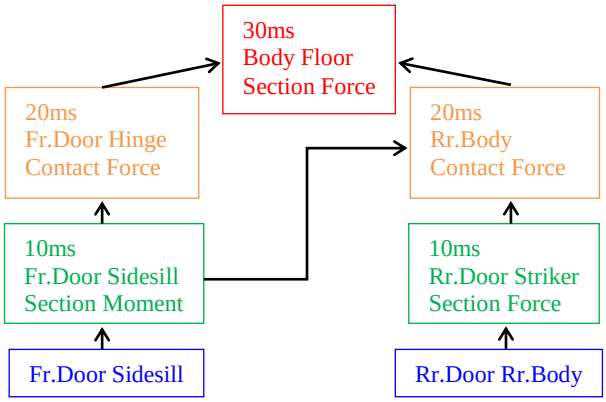

Fig.2 Graph Structured Analysis with floor section force

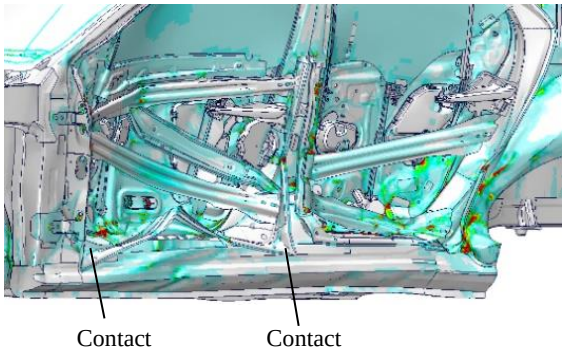

Fig.3 Contact points required for load transmission