Special Feature: Innovative Technologies for the Automotive Structure and Processing

Overview

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It is often said that the automotive industry undergoes a period of change once every 100 years. In order to support high-mix, low-volume production, it is important to quickly develop inexpensive and high-performance vehicle and to innovate the production process. This special feature introduces research related to manufacturing and evaluation based on the design methods that constitute such processes.

First, module design for manufacturing new lightweight automotive body structures is proposed at a conceptual design stage. This modularization method is based on beam element topology optimization and cluster analysis.

Next, an aluminum moldless casting method is introduced. Using this technique, frame components with inner ribs, variable cross-sections and bent geometries can be fabricated flexibly. Another study is on an evaluation technique for delayed fracture susceptibility. The effects of applied stress and surface treatment on hydrogen absorption for a high tensile steel sheet are investigated.

For carbon fiber reinforced plastics (CFRP), two calculation techniques are proposed. One is a simulation of an injection molding process in which resin flow and fiber behavior are coupled. From this simulation, the fiber orientation and length reduction are predicted. The other is a multiscale simulation technique for predicting the strength and fracture characteristics of CFRP. This can significantly reduce the computational costs of finite element analyses used to derive the macroscopic mechanical properties of complex CFRP.