講演番号	081

Verification of Circuit Parameter Optimization Technology for ECUs through Inter-company Collaboration Using an Electro-mechanical Coupled 1D Model

Masashi Inaba[1)] Masanari Ueda[2)] Osamu Seya[3)] Kota Saito[4)] Yoshiko Ikeda[5)]

Keita Inoue[1)] Hiroki Nakamizo[3)] Wataru Hijikata[3)] Hideaki Fujita[3)] Takuya Shinoda[1)]

1) DENSO CORPORATION 1-1 Showacho, Kariya-city, Aichi, 448-8661, Japan (E-mail:masashi.inaba.j2s@jp.denso.com)
2) Siemens Electronic Design Automation Japan K.K. 4-7-35 Kitasinagawa Shinagawaku Tokyo, 140-0001, Japan
3) Institute of Science Tokyo 2-12-1 Ookayama, Meguro-ku Tokyo, 152-8550, Japan
4) Murata Manufacturing Co., Ltd. 1-18-1, Hakusan Midori-ku, Yokohama-shi, Kanagawa 226-0006, Japan
5) Toshiba Electronic Devices & Storage Corporation 580 - 1, Horikawa-Cho, Saiwai-Ku, Kawasaki, Kanagawa, 212-8520, Japan

KEY WORDS: Optimization, Simulation, Modeling, VHDL-AMS, Thermal, Computer aided engineering, ECU (E1)

The demand for shorter development cycles of automotive ECUs has intensified. This trend has promoted the adoption of electromechanically coupled one-dimensional (1D) modeling.In our previous study, we employed a model shared across multiple companies. Using this model, we analyzed actuator drive-circuit behavior and predicted power-device losses and temperature rise.The predictions were experimentally validated using a dedicated prototype board.

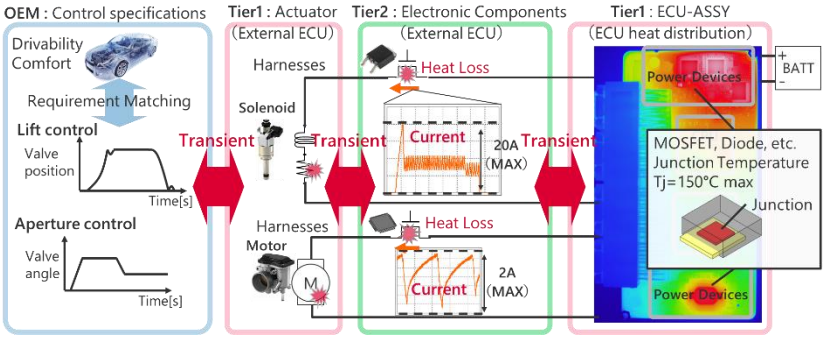

Fig.1 Using MBD for Powertrain ECU design requires multi-domain simulation

An electromechanical 1D model can simulate circuit operation and actuator loading within a single framework, while also estimating device losses and the resulting junction temperature rise. This makes it suitable for design-space exploration and parameter optimization. In this study, we apply a genetic-algorithm-based optimization to an electrical–mechanical–thermal coupled 1D model to automatically determine circuit parameters and quantify the reduction in power-device losses and junction temperature. In the DC–DC converter, the optimized design reduced the peak MOSFET junction temperature by 67.1% compared with the baseline configuration. Finally, we discuss practical considerations for production ECU hardware design.

Fig.2 Control circuit board for accuracy verification

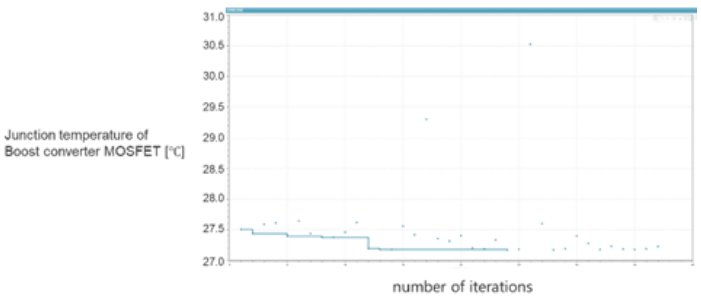

Fig. 3 Best Objective Value vs. Iteration