Trends and Effects on Development Methods and Tools

Calibrating ECUs

The developments and challenges of the next five to ten years in the area of measurement and calibration of ECUs will be determined by global trends and will involve several changes. Established work methods are frequently reaching their limits, and adoption of new approaches by companies is inevitable. Data-based calibration methods, “intelligent” data management with virtually transparent data exchange, and flexible integration of expert knowledge via apps, among other things, will supplement the work of the application engineer.

In the view of numerous managing directors in the automotive industry, the key trends influencing this sector in upcoming years will include handling of new markets, standardization of vehicle platforms and modules, driver assistance systems, and further optimization of internal combustion engines [1]. This will create new demands on companies and their development departments, requiring fundamental changes to many work methods.

For example, while new markets require much closer collaboration with customers, business partners, and service providers at the international level, more standardization might lead to a greater number of variants. Further development of combustion engines, in turn, will further increase the already high level of complexity of the power train. Today’s modern diesel drives with exhaust gas cleaning already require calibration of over 60,000 parameters, with 4, 8, 10, or 20 variants.

The complexity and configurability of ECUs is also continuing to increase in other electronics areas such as the chassis or body and for assistance systems. Even if only 5000 parameters have to be managed for chassis systems, engineers must ensure this for 80 to 100 product variants. In the case of ultrasonic sensors, a typical component of assistance systems, there are only a few calibration values but the sensors are installed in 1000 vehicle variants. Efficient development, testing, and validation of driver assistance systems is possible only through direct integration with the existing measurement and calibration tool. In addition to high data rates, the sensor data fusion calls for expansion of existing signal-oriented concepts in the direction of object-oriented representation and processing of information.
From the Virtual Calibration to the Automatically Generated Parameter Set
Other trends include calibration in virtual environments, automatic generation of knowledge from existing datasets, and migration of web technologies into industrial work sequences. While calibration has shifted in recent years away from the vehicle to test benches and HIL systems, in the future more calibration tasks and optimizations will be carried out with simulations and models in the lab (Figure 1). This spares companies the need for expensive prototypes and test vehicles. The approach will no longer be simply to measure signals and collect and manage data. Rather, automatic generation of results will be the focus. The existing database will serve as the basis for creating new parameter sets and variants using corresponding calculation algorithms.

Future-proof Tool Chain for ECU Calibration
All of these trends will have a lasting impact on the tool chains for measurement, calibration, and diagnostics in the coming years. As a tool manufacturer supplying high-performance products for ECU calibration to customers both now and in the future, Vector is focusing intensively on these trends. The company has identified four strategic topics in the area of ECU calibration that it is concentrating its efforts on: assistance systems, added value in power train, flexible interfaces that allow tool departments of companies or external service providers to easily integrate Vector products in their solutions, and integrated, reliable provision of Internet technology in measurement and calibration solutions.

Reliable, Value-added Integration of Cloud Technologies
Social Media, Internet of Things, and Web 3.0 are showing us how data exchange, connectivity, and expandability can be realized today in a simple, all-encompassing manner using apps. It is a matter of providing the potential of these approaches as integrated, reliable company solutions in order to tap into it for measurement and calibration applications. For example, applications for measurement data analysis offer excellent potential for added value through use of these technologies. While previous solutions required use of expensive special software and its time-consuming configuration, a cloud solution is a straightforward means of providing simple sharing of measurement data as well as central algorithms for data mining.

Current Solutions Ideally Suited for Further Development
Calibration tasks in power train are multi-faceted and range from measurement data acquisition to offline calibration. The latter focuses on working with measurement files and parameter values. The application engineer creates and manages variants or uses model-based or virtual technologies for optimization and dataset generation.
CDM Studio is a stand-alone calibration data handling tool. vCDM is an enterprise solution for calibration data management. CANape, which in combination with Simulink, is a powerful platform for model-based calibration (Figure 2). The bandwidth requirements and response times during measured data acquisition and online calibration are rapidly increasing. Chassis and assistance systems now require transmission rates of up to 100 Mbps. With the VX1000 measurement and calibration hardware, a fast, direct, and cost-effective interface to the ECU is available that communicates with the ECU using the XCP on Ethernet standard ASAM protocol and can be easily integrated in the housing in a space-saving manner using a POD (Plug-on-Device).

For data exchange inside the team, solutions are in preparation that will allow sharing of work results, measured values, parameter sets, reports, etc., via a trusted cloud virtually at the press of a button. The company network as well as a cloud hosted by the tool manufacturer may be used for this. Whether in the office or on the test track, data can be read, changed, written back, and synchronized easily.

**Vision 2020: Calibrators Workbench**

Scalability paired with investment protection will also be at the top of the priority list for customers for a number of years. Needed are tools and implementations that grow with requirements – from a single workstation to teams and finally to an enterprise-level solution. The specialists of Vector have named their vision of the next generation work environment the “Calibrators Workbench” (Figure 3).
What is meant here is an integrated offering of tools that are all equipped with a uniform user interface and the same look and feel. The tools provide similar methods and allow editing, management, and analysis of calibration data using a variety of tools. Essential features of the Calibrators Workbench will include expandability using apps or vApps (virtual apps). This will enable engineers to reuse existing functionality (reading/writing of measurement files, parameter set files, map editors, etc.) for their own applications, which reduces development expenses. It will thus be possible to buy additional expert knowledge when needed and easily integrate it into the Calibrators Workbench. The apps equipped with server or cloud infrastructures can originate from Vector or external service providers. As a central node for knowledge management, Calibrators Workbench will ultimately provide a simple cloud-based sharing of work results.

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