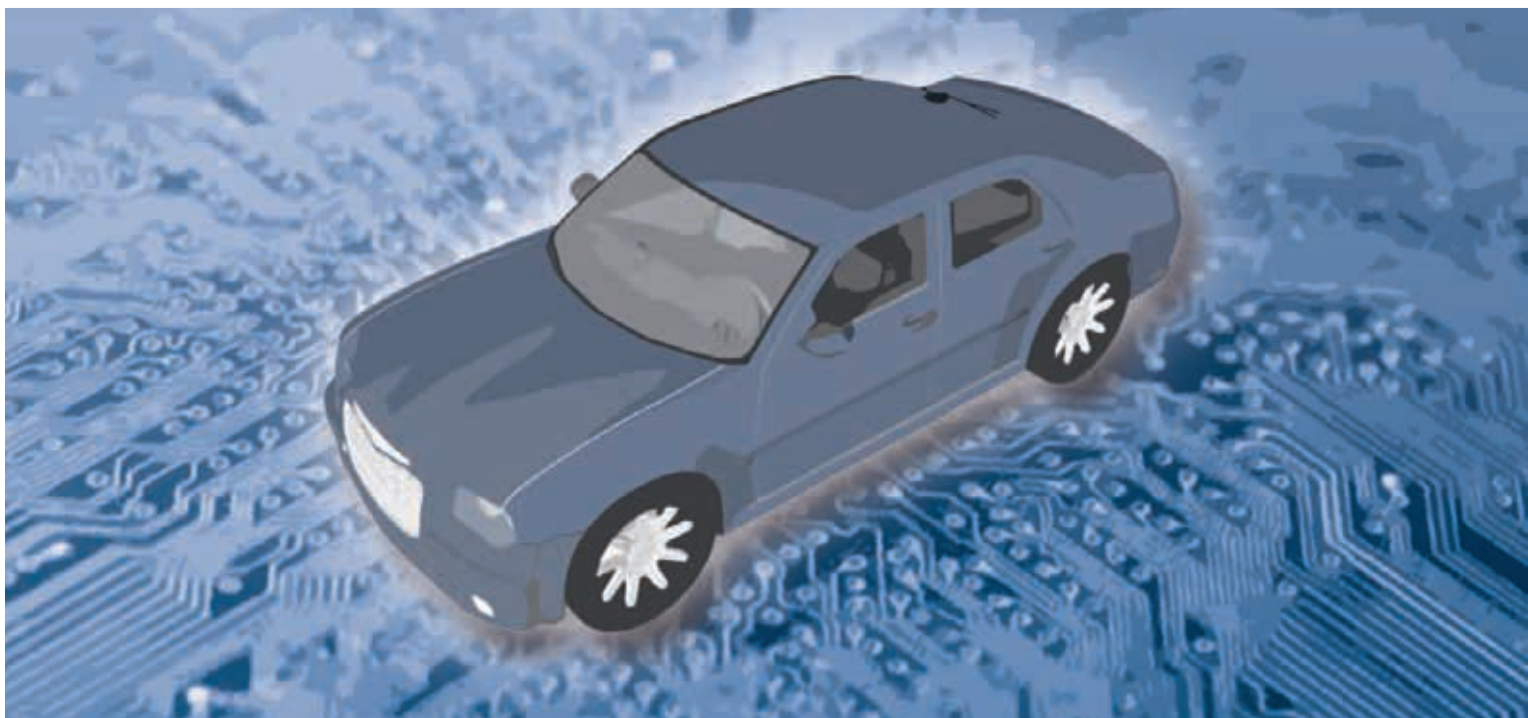


Electronic Control Units

for Advanced Function Development



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Controlling tomorrow's efficient technologies today



Introduction

As the complexity of the modern vehicle continues to increase, emphasis placed on the development of vehicle systems has led to ever-changing requirements for advanced electronic control units. Whether it is the influence of environmental, performance, safety or legislative requirements, the number of ECU's in the typical passenger car now exceeds 50, with the size of embedded software equaling some of the more sophisticated avionic systems.

IAV has been involved in the increased application of electronics to passenger and commercial vehicles since 1983. Experience in the development of advanced vehicle systems, beginning with early concepts for ignition and fuel control, transmission, ride and handling control, safety systems, hybrid and electric drive technologies and telematics, has provided a foundation for IAV to develop flexible tools and customer solutions to meet the ever-increasing demands for the development of electronic control units and embedded control systems.

Such tools not only provide a flexible development environment to meet today's challenges, but also offer a suitable platform for developing future technologies. The new approach allows for the transition from advanced R&D to mass production in a manner that meets cost and time requirements. Moreover, IAV has leveraged mass production development processes in the development of target prototyping solutions that mirror industry standard tools and methods.

IAV can provide a full spectrum of solutions for developing control systems of future production vehicles. These range from algorithm and software development, electronic hardware specification and design to developing vehicle electrical systems and system testing throughout the vehicle.



Industry practice transformed into rapid and robust solutions



Gaseous-Fuel Engine Controller

IAV has developed a gaseous-fuel sequential control unit that provides the means for upgrading virtually all gasoline concepts to run on gaseous fuels quickly and cost effectively without having to modify the existing engine control unit. This innovation from IAV combines the use of the gasoline system's validated calibration data with the extended flexibility given by the sequential control unit and an optimized OEM-specific component set for gaseous-fuel systems.

In IAV's newly developed concept, the original engine control unit works in conjunction with the new control unit. A high-precision analysis unit processes the signals and computes the necessary adjustments (i.e. the optimum gaseous fuel injection times) which, depending on the operating point, may differ from the values for gasoline operation. By combining the existing engine control unit with the sequential control unit, the original gasoline calibration is left unchanged. This allows manufacturers to use the same gaseous-fuel control unit for different engine versions.

Possible Applications

- ▶ Bi-fuel EMS adaptation
- ▶ Mono-fuel EMS adaption
- ▶ Validation of gaseous-fuel strategies (cold-start, temperature control)



Gaseous-Fuel Engine Controller



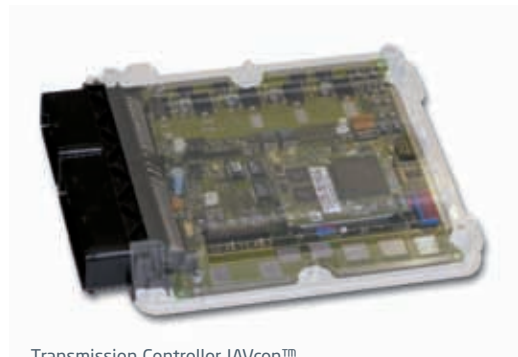
Transmission technologies are routinely developed and verified

Transmission Controller

IAV's rapid prototyping transmission controller, IAVcon™, is the ideal development tool for automated manual transmissions, dual-clutch transmissions and powertrain controls for hybrid vehicles. IAVcon™ offers more than hardware: it also includes the flexible development environment InDet, with interfaces to popular rapid development systems, such as ASCET, MATLAB®/Simulink®/TargetLink and calibration tools, via CCP and XCP. InDeT allows code integration from several different sources into one target program very easily. The robust design enables the controller to work reliably in various automotive environments.

Possible Applications

- ▶ Gear selection strategy
- ▶ Strategies for shifting behavior
- ▶ Clutch control
- ▶ Validation of new strategies (torque interface, virtual sensors)
- ▶ Validation of new algorithms (pressure profiles, adaptive and torque-based strategies, diagnostic functions)
- ▶ Compatible with electronic throttle control, cruise control, brake-by-wire and shift-by-wire



Transmission Controller IAVcon™



IAV designs flexibility to handle ever-changing requirements of future vehicle systems

Universal Control Unit

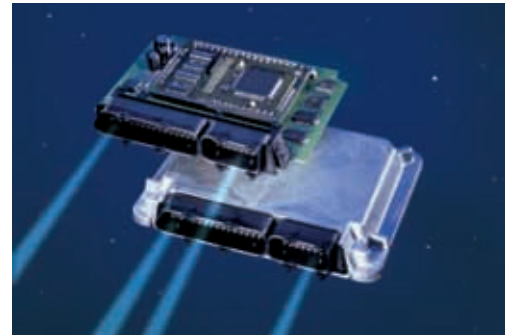
IAV's universal rapid prototyping controller is designed to be a flexible solution to satisfy broad requirements in automotive control systems. As a stand-alone unit or as an extension to the existing controller setup, the Universal Control Unit (UCU) can be easily adapted for development vehicles.

The basic controller board holds all power components, high current layers and input and output circuits (analog and digital). Separate microprocessor board modules can accommodate low to high level requirements (e.g. Infineon C167, Motorola MPC555, Infineon TC 1775 or Infineon TC1796 with MFR4200 FlexRay-Controller). The modularized UCU system can quickly be configured to the input and output stage setup desired. Communication is available via the following applications: J1850, R232, Ethernet or up to two CAN-buses.

The UCU is a solution providing the most flexible options to demonstrate and achieve the necessary requirements, and allows for new algorithms bypassed to an existing system or completely new controller strategies.

Project Examples

- ▶ Algorithm development for Autonomous Cruise Control (ACC) applications
- ▶ Chassis control algorithms
- ▶ Engine control algorithms
- ▶ Powertrain management for hybrid and electric drives
- ▶ Battery management
- ▶ Display and dash board controls
- ▶ Air-conditioning
- ▶ User specific CAN tools
- ▶ Bus gateways
 - CAN <-> analog/digital
 - CAN <-> CAN
 - CAN <-> serial



Universal Control Unit



Advancements in the field of chassis control systems have enabled the adjustment of chassis characteristics depending on driving situations

Universal Chassis Controller

Due to IAV's increased activities in the field of electronic chassis control, the Universal Chassis Controller (UCC) was designed to satisfy the needs of customers and development teams.

With the UCC, IAV establishes a multi-functional chassis controller system as a flexible automotive development platform. It is the optimal base for pre-development of chassis systems, transferring to production application at a later date.

The architecture of the UCC consists of two powerful controllers. The Infineon TC1775 is part of the baseboard. Following the modular structure of IAV's UCU family, a controller board can be connected to the baseboard. The first version of the UCC is available with a MPC565 controller board. Both controllers communicate via a DPRAM. All necessary inputs and outputs can be controlled by both controllers. Due to this architecture, safety structures may also be implemented.

Field of Application Examples

- ▶ Active damping control
- ▶ Air suspension
- ▶ Tire pressure monitoring
- ▶ Active roll control (stabilizer)
- ▶ Electric power steering
- ▶ Stability control



Universal Chassis Controller



Model-based software development tools leveraged from the concept phase through production

Application Software

Drawing on experience, IAV has created an application software development environment with an eye to production methods, processes and toolchains. Such software-build environments leverage industry standard automatic code generation and calibration tools from The Mathworks™, dSPACE and ETAS.

The production influenced development process allows the client's advanced development activities to be readily carried over to the production embedded controller without significant effort.

This development environment provides the engineering team with a tool that can be utilized from the concept phase to the implementation test and validation for the production release. Quality will be improved by completing development activities in a common and consistent environment.

IAV Application Software Experience

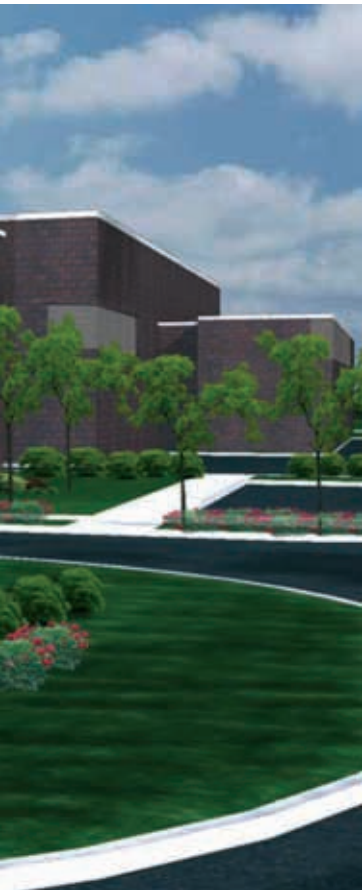
- ▶ Gasoline, diesel and alternative fuel advanced engine management systems
- ▶ Parallel, power-split and series hybrid electric vehicle powertrain and energy management systems
- ▶ Advanced transmissions including dual-clutch, automated manuals and planetary automatics
- ▶ Chassis control functionality, such as dynamic ride control and air suspension
- ▶ Functional safety concepts



Tools to develop future technologies



IAV's new Technical Center North America



About IAV

IAV Group is a leading global automotive engineering service provider, employing more than 3,000 personnel throughout Europe, Asia and the Americas. Founded in 1998 as the North American subsidiary of IAV GmbH, IAV Automotive Engineering Inc. develops breakthrough concepts and technologies – from powertrain design and development to controls and electronics – for future vehicle generations. Clients include leading automotive manufacturers and component suppliers, all of whom rely on the knowledge of IAV's engineers to help them design and develop some of the industry's most advanced engines and powertrains. The IAV Technical Center North America is now open in Northville, MI. The technical center includes four state-of-the-art development/test cells. With this exciting new facility, engineering capabilities have expanded to include full service projects, further cultivating the inventive spirit, enthusiasm and commitment to success for which the IAV Group is known.



Excellence in automotive research and development – a concept IAV applies across the globe

