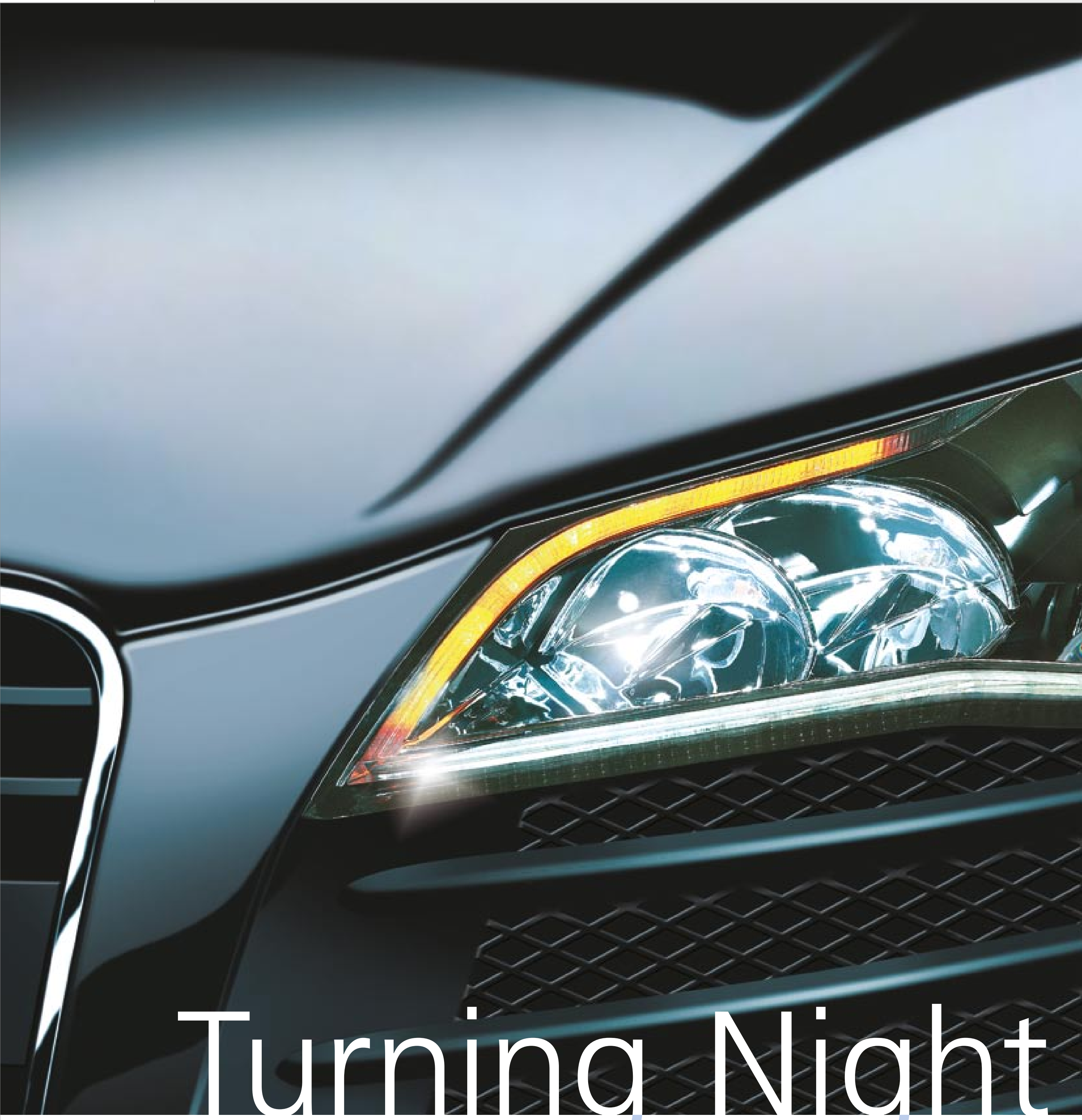


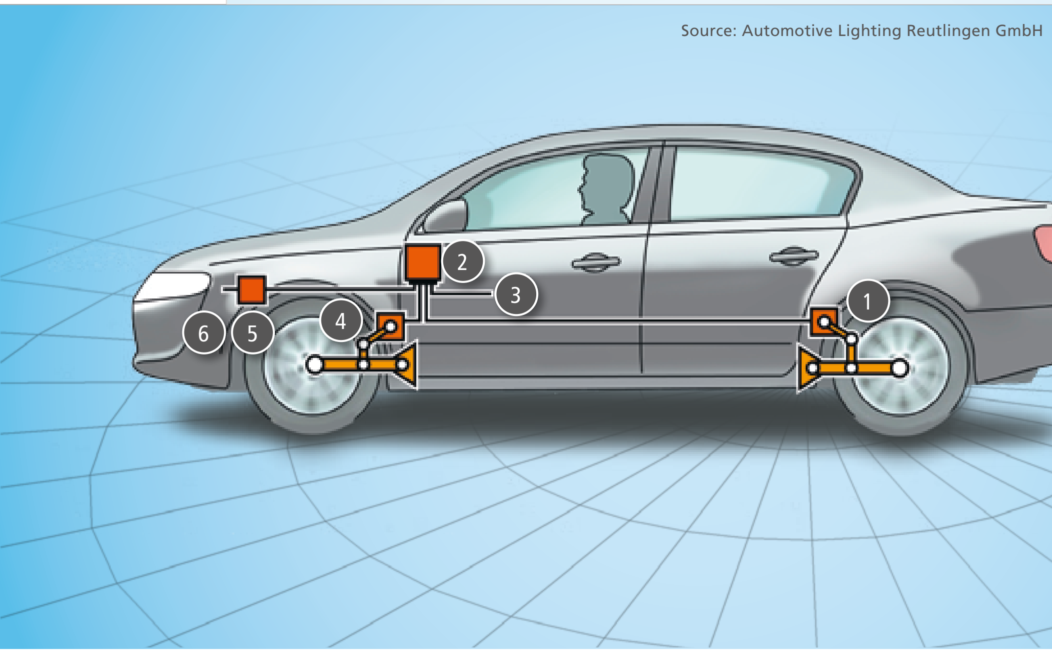
Turning Night into Day

Xenon and LED vehicle lights

Source: Automotive Lighting Reutlingen GmbH

We've come a long way from the gas lamps on the first motor vehicles to the xenon and LED headlights of today. But the goal is the still same: shine as much light as possible on the road, not at the sky, and never glare oncoming traffic.

Source: Automotive Lighting Reutlingen GmbH



The components of the automatic dynamic automatic vertical aim control.

Light up the Road, not the Oncoming Traffic

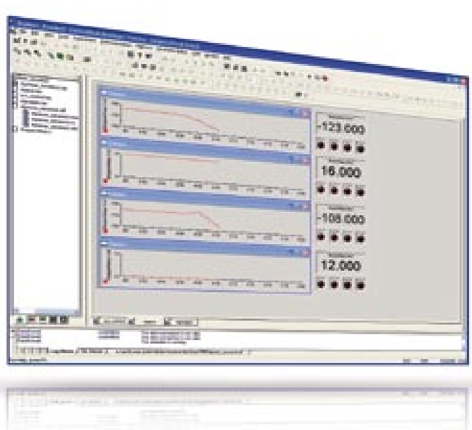
Heavy vehicle loads, sudden acceleration and abrupt braking maneuvers cause vehicles to tilt longitudinally. To keep the maximum amount of light on the road, the angle of the headlights has to change to compensate for vehicle movements. This is what automatic headlight adjustment does. oncoming traffic. Automatic AVA control uses either one or two axle sensors: one fitted to the rear axle and an optional one on the front axle. These capture the angle of the car body and compare it with the zero position defined by the OEM. If the two values differ, the sensors send data for corrective action to the headlight adjustment ECU. The ECU uses this data to calculate a new reference value so that the stepper motors can regulate the headlight level accordingly. Automatic vertical aim control can be static or dynamic.

- In static AVA, the vehicle angle caused by the vehicle load is measured and adjustment is performed before the vehicle moves off. Any changes that occur while the vehicle is moving, due to intense acceleration, braking, etc., are ignored.
- Dynamic AVA also compensates vehicle angles caused by braking and accelerating actions. For example, emergency braking can cause the vehicle to tilt forward

> "The DS1006 Processor Board from dSPACE has sufficient computing power to simulate complex and real-time-close models."
>
> *Mathias Bako, Automotive Lighting Reutlingen GmbH*

Automatic Vertical Aim Control

At Automotive Lighting, we develop automatic vertical aim control systems (AVA) and also advanced frontlighting systems (AFS) for halogen and xenon headlights. Halogen headlights can be adjusted manually by means of a handwheel, but automatic adjustment is mandatory for xenon (high-intensity discharge) and LED headlights by law. This is because of their higher luminosity: If they are not adjusted properly, glare can be a hazard to



The evaluation of measurement results was handled in ControlDesk.

> "The dSPACE hardware is exactly right for our purposes and was integrated very successfully into our test environment."
>
> *Mathias Bako, Automotive Lighting Reutlingen GmbH*

by up to 1.5°, shortening the range of the light cone from 100 m to 40 m. Stepper motors are used to control the headlights dynamically.

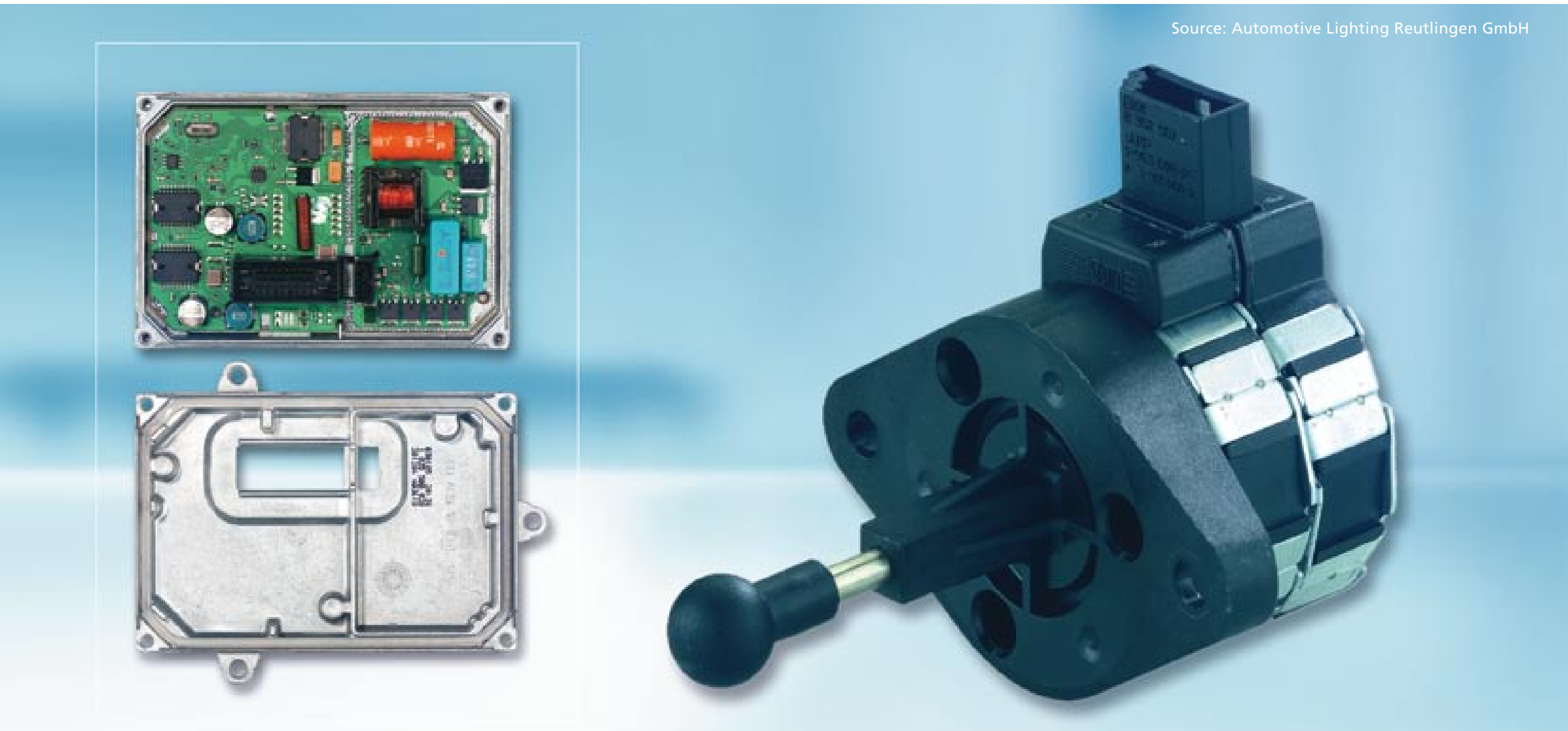
Advanced Frontlighting

Especially on winding country roads, improved visibility ensures greater safety, comfort, and driving pleasure. This motivated Automotive Lighting to develop advanced frontlighting systems, a new kind of dynamic directional light. An electronic control unit continuously evaluates various vehicle dynamics parameters such as steering angle, speed, and yaw rate. The system uses the evaluation results to move the low-beam headlights horizontally according to the radius of each road bend, ensuring that the road is optimally illuminated. This method provides up to 70 % more visibility compared with today's headlight systems.

Test Bench for AVA and AFS

We use hardware-in-the-loop (HIL) simulation on our test bench to test whether the ECU and the stepper motors for the AVA and AFS functions are working correctly. Our ECU is connected to a dSPACE Extension Box. The hardware in this simulates the sensor system and checks the steps of the stepper motors in real time. To simulate the sensors, we created a MATLAB®/Simulink® model that runs on a DS1006 Processor Board. The resulting sensor voltage, which indicates the vehicle's angle of tilt, is forwarded to the ECU via the DS2201 Multi-I/O Board. The ECU uses it to calculate the new reference actuating variable, which it then passes to the stepper motors. During a critical driving situation such as an abrupt braking maneuver, highly dynamic headlight control is vital. We therefore had strict requirements regarding the motor's testing precision. We can test the individual steps of the stepper motor in real time with the DS5001 Digital Waveform Capture Board. A LIN bus system is used for communication between the ECUs involved in automatic vertical aim control and for controlling the headlights via actuators. To achieve

The headlight positions are regulated via a stepper motor and our ECU AL box.



Source: Automotive Lighting Reutlingen GmbH

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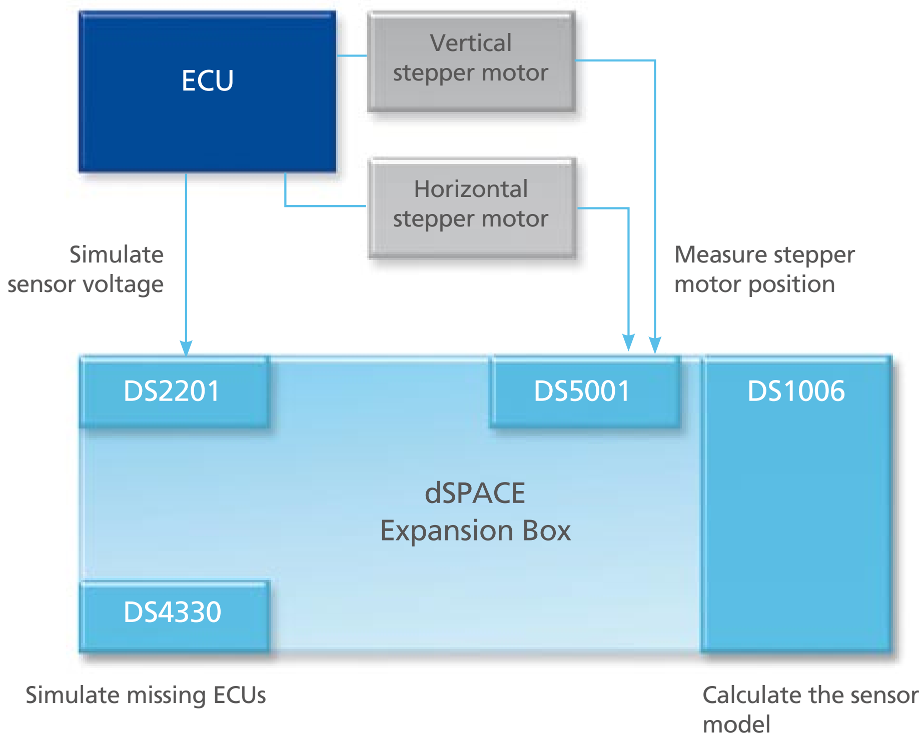

The dSPACE simulation and testing hardware is contained in a compact extension box.

Source: Automotive Lighting Reutlingen GmbH

greater test depth, one or more ECUs are simulated as LIN nodes with the DS4330 LIN Interface Board in another test stage (according to the V-cycle). The simulated LIN nodes behaved in exactly the same way as real bus nodes.

We managed and controlled the evaluation of measurement results with dSPACE ControlDesk. We used Python scripts to automate project-specific procedures and adjust them precisely to our requirements. This included actions such as starting ControlDesk, loading the application to the DS1006, running the simulation and reading out the measurement values.

Mathias Bako
Automotive Lighting Reutlingen GmbH
Germany

Outlook

Our test bench still has free capacity for extra computing power and extensions, so we aim to add further innovations in the future. For example, communication can be performed via FlexRay as well as via LIN and CAN. Another conceivable test setup would be to test the intensity of the light via optical feedback.