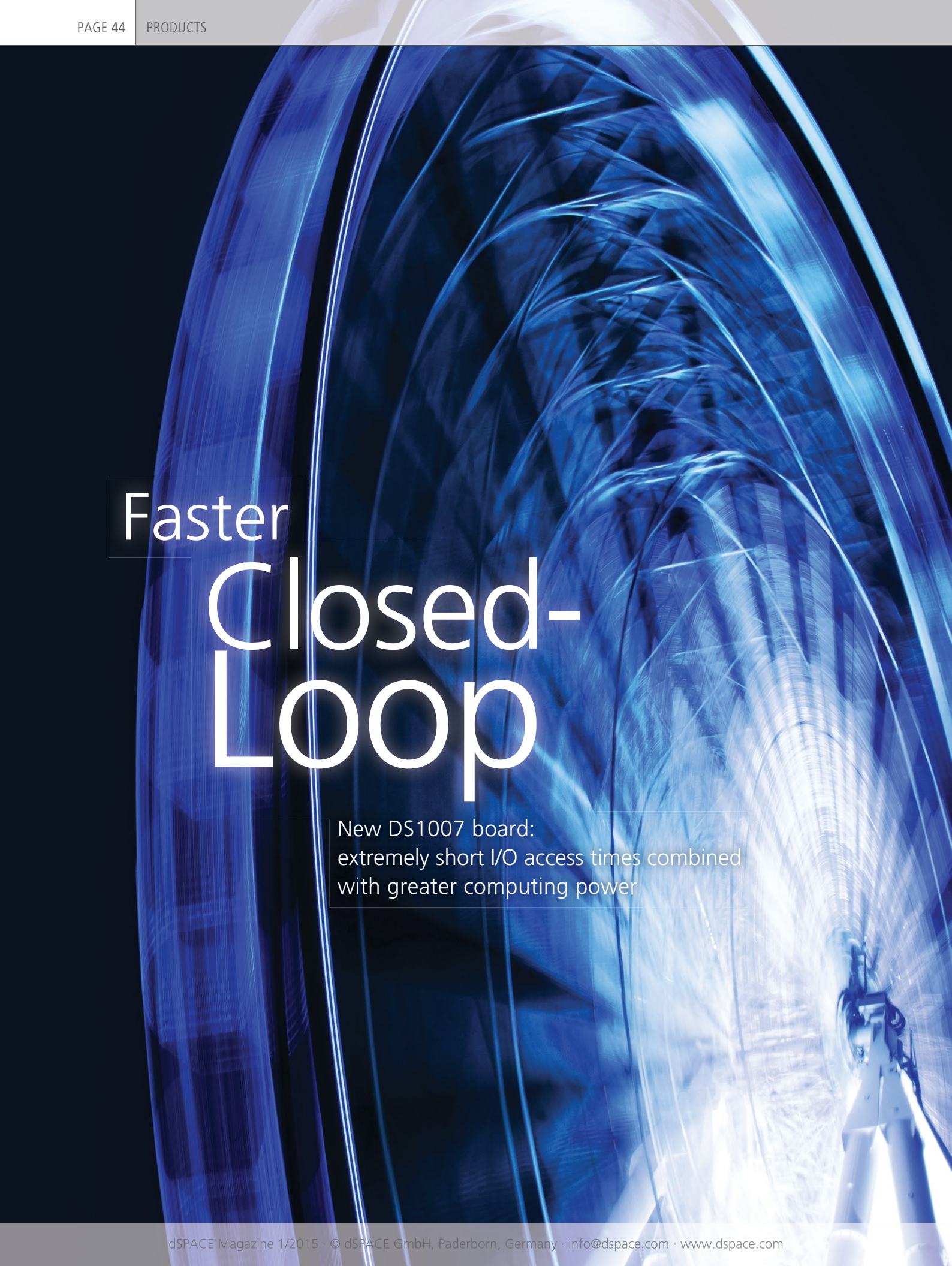

Faster Closed-Loop

New DS1007 board:
extremely short I/O access times combined with greater computing power

The verification of control strategies has always entailed strict requirements for reactivity and I/O latency in rapid control prototyping. At the same time, the demand for greater computing power is continuously increasing. The new DS1007 PPC Processor Board rewrites the rules for this trade-off.

Rapid control prototyping is used in many different areas of control engineering to test and verify control strategies under realistic conditions. Thanks to the increasing computing power of today's processors, even computation-intensive applications can be processed in time. But a real-time system not only depends on the model's computing time. The access time to the I/O interfaces also plays an important role (figure 1). When there is a high number of I/O operations or tough demands on the system's reaction time to external events, the I/O access time can become a bottleneck.

Low I/O Latencies

dSPACE developed the new DS1007 PPC Processor Board specifically for computation-intensive applications that place high demands on I/O access times. The board yields the low latencies by combining two components: the architecture of the implemented QorIQ P5020 PowerPC processor with its 32-bit parallel data interface and the peripheral high-speed (PHS) bus optimized for short access times.

The past years have seen a considerable increase in the model complexity of digital controllers and, thus, a greater demand for more computing power. Thanks to its two processor cores, a processor rate of 2 GHz, and a larger cache memory, the DS1007 provides computing power per core that is three times higher than that of its predecessor, the DS1005. Its 512 KB L2 cache memory per core and a combined L3 cache of 2 MB give the processor board enough performance reserves for computing large models (figure 2).

Fast Data Acquisition

For many applications in rapid control prototyping, both calculating the controller and acquiring the controlled system's sensor data is of

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In closed-loop performance, the I/O access time is just as important as computing power.

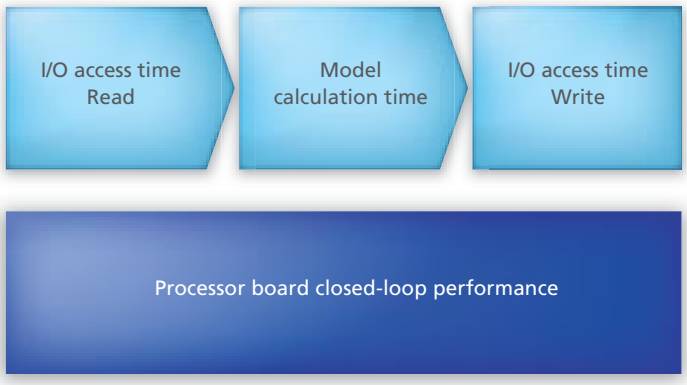


Figure 1: The actual closed-loop performance depends on the processor's computing power, and also on the processor's ability to keep the I/O access time of the data bus as short as possible.

utmost importance. The sensor data are needed as control variables for the controller, and they can also be used to feed signal values into the system validation during closed loop control. To save the acquired data, they have to be passed to the host PC, or written to a USB mass storage device. In addition to the USB interface, the DS1007 has an integrated Ethernet host interface with a data throughput of more than 20 MB/s. The Ethernet host interface lets the DS1007 be integrated into a network. This makes it possible to spatially separate the host PC and the real-time system, which is often required in test bench uses cases, for example.

Real-Time Ethernet-I/O Interface

The DS1007 has two additional Gigabit Ethernet interfaces that can be integrated directly into the real-time application by using the related RTI blockset for Simulink® (figure 3). Via these interfaces, users can connect the real-time model with additional systems and components, such as other laboratory equipment or PC-based ADAS applications (eHorizon, sensor fusion, image processing, etc.). The DS1007 can also be directly coupled with a dSPACE DCI-GSI2 (generic serial interface) to bypass electronic control units – no further I/O board is required.

Perfect for In-Vehicle Use

The DS1007 has a robust and compact single-slot size and integrated host interface, a flash-based application memory and a USB interface for connecting mass storage devices – making it ideal for autonomous in-vehicle use. Just a few seconds after system startup, the processor board with the application stored in the flash memory is ready-for-use.

Comparing the DS1007, DS1006, and DS1005

As the successor of the DS1005, the DS1007 was optimized for use in dSPACE prototyping systems. With its considerable improvement in computing power and data acquisition, it still covers the need for in-vehicle suitability, low I/O latencies and short boot times. With its improved host interface and the Ethernet-I/O interface, the new processor board also brings added value for hardware-in-the-loop (HIL) applications with a moderate model complexity. In comparison, the DS1006

Figure 2: In addition to the processor rate, the available cache memory is also crucial for fast model calculation.

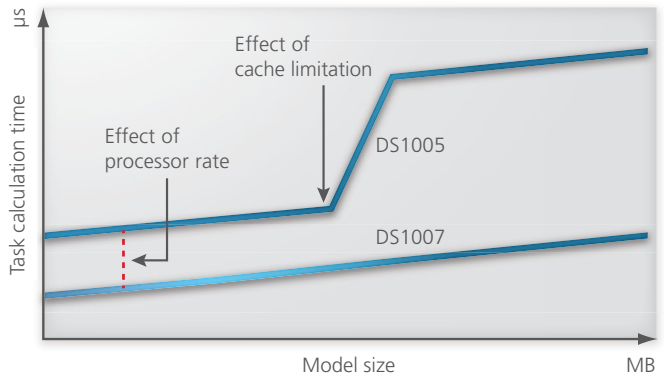
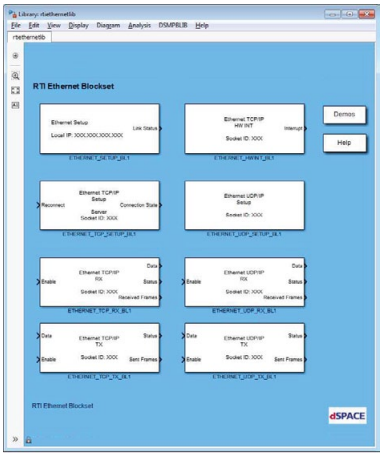


Figure 3: Real-Time Interface blockset for integrating Ethernet devices into the real-time application.



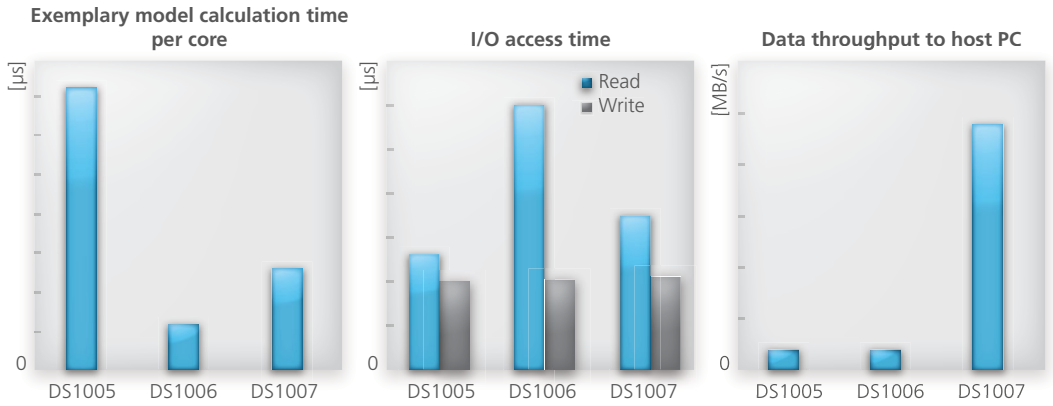


Figure 4: Qualitative comparison of the features of the DS1005, DS1006, and DS1007: there is a perfect processor board for every use case.

and its powerful 2.8 GHz quad-core processor can unfold its full potential when calculating complex plant models, as required in hardware-in-the-loop applications, for example. However, there is no strict separation between the application fields of the two boards. What is important is that there is a processor board for each use case. When using only one board ("one-fits-all"), this would not be possible. Figure 4 depicts the relevant properties of each processor board. Customers who are reaching the limits regarding the computation power of the DS1005 are recommended to use the DS1007 to bring their system up to date. They simply need to exchange the DS1005 with the DS1007 – and can continue to use all other dSPACE I/O boards. When it comes to costs, the DS1007 is particularly attractive for new users, because unlike the DS1005, it does not require an additional host interface board and the related compiler is provided free of charge. Where several DS1005 PPC Boards were required to provide sufficient computing power, they can now usually be replaced by just one DS1007. The DS1007 has been available since mid-2014 and more features will be added in future releases.

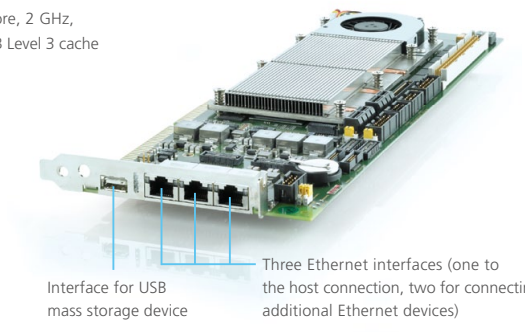
For example, it will be possible to couple several boards to form a multiprocessor system and the processor board will support XCP on Ethernet, NVRAM, ModelDesk, and Real-Time Testing. ■

Figure 5: Host interface, Ethernet extension interface, and mass storage interface are already included on the processor board.

Profile: DS1007 PPC Processor Board

Technical properties:

- Freescale QorIQ P5020, dual-core, 2 GHz, 512 KB L2 cache per core, 2 MB Level 3 cache
- 1 GB DRAM
- 128 MB flash memory
- Gigabit Ethernet host interface
- Gigabit Ethernet I/O interface
- USB interface for mass storage
- Short boot times
- In-vehicle suitability
- Low I/O latencies



Typical fields of application:

- Rapid control prototyping, validation
- Data acquisition
- Test bench, laboratory, vehicle
- Controlling combustion engines and electric motors
- Active noise reduction
- Driver assistance systems
- Vehicle dynamics
- ECU bypassing