Forging New Pathways in Testing ISOBUS Task Controllers

Simulations replace inflexible and time-intensive test methods

The tractor is a truly multi-talented field machine due to its ability to interact with many different implements. As long as the tractor remains a machine that offers pure pulling and power take-off functions, and no other interaction occurs with the implement, operation of the two devices is relatively uncomplicated, but it is not very efficient due the lack of an additional interface. Nonetheless, modern agriculture requires intelligent, automated solutions, which support such functions as variable spread quantities for seeds and documentation of the work performed on the field.

Yet, as complexity grows and more intelligent functions continue to make in-roads into agricultural technology, this increases the effort needed to keep operation and handling as simple for the farmer as it was before. Long, drawn out start-up processes are counter-productive, not least in terms of customer acceptance of modern agricultural technology. It must be possible to rapidly and smoothly connect any of a wide variety of implements to the tractor and have the tractor’s electronics ‘understand’ it immediately.

**ISOBUS compatibility and conformity are top priority**

The ISOBUS application plays a key role here. ISOBUS was created so that tractors, implements and operator terminals could communicate with one another and exchange data. The technical details are defined in the ISO 11783 series of standards, and they cover all topics from the ISO reference model to diagnostics to the file server. To ensure smooth interoperability of devices from different manufacturers, extensive tests are indispensable for both tractor and implement producers. Along with the obligatory conformity tests, development departments must play through numerous other test scenarios. In addition, manufacturers regularly organize...
“Plug Fests” where they verify that their product functions are field-ready in their interactions with the products from other manufacturers.

One of the forerunners of modern agricultural technology is John Deere, a company with a long tradition. Its products range from tractors to field sprayers and balers to seeding, harvesting and chaffcutter machines. Not only does it develop agricultural machines, but also construction machines, forestry machines and public utility equipment as well as machines for lawn, property and golf course maintenance. In addition to its German subsidiaries in Zweibrücken, Mannheim and Bruchsal, the American agricultural machine specialist opened another business site in Kaiserslautern in early 2010. Employees in the new European Technology and Innovation Center (ETIC) work on future technologies and bring associated products to production maturity together with development departments at other sites. Precision farming, the integration of intelligent technologies in machines and agricultural electronics, represents a focal point of work at Kaiserslautern.

From farm computer to automatic section control in implements

The concept of Precision Farming illustrates current trends in agricultural technology and puts them in focus. The goal here is to attain the greatest possible yield and maximum economy by optimal use of all available resources such as machines, seed stock, fertilizers, fuel, time, etc. The farmer takes the parameters of the planned field operations on the farm computer and uploads them to the operator’s terminal in the tractor by memory card or USB stick, or in the future via WLAN.

Telematics and satellite navigation also make important contributions in combination with steering and track guidance systems as well as section control. The result is seamless application of seed stock and fertilizers without any areas of faulty application. At the same time, the technology provides for minimal overlaps on wedge-shaped fields and saves raw materials at field borders. Implements with section control are subdivided into multiple sections, which can be activated or deactivated independently of one another. Since all activities are logged, movements of the tractor during which the implement either protrudes beyond field boundaries or overlaps already covered areas result in automatic deactivation of the relevant sections.

The Task Controller as an interface to device control

These and other functions mean that the tractor electronics must have a precise knowledge of the implement’s technical data and functions. The ISOBUS operator’s terminal, as a part of the tractor electronics, is, in many cases, not just a user control and display system, but a minicomputer on which multiple applications run simultaneously. Such an application is the Task Controller, which is described in ISO 11783 Part 10. Ideally, it simultaneously serves as a documentation and control system with an interface to the Farm Management System via the TaskData.xml file. In the John Deere GreenStar 2630 display, the Task Controller represents an interface between the John Deere documentation system and an ISOBUS implement. The first time it is connected, the Task Controller loads a “Device Description File” from the implement’s job computer. This...
layout or handling. Each company follows a different operating philosophy, and some boxes are pure simulations, while others largely match the real electronics. Before test personnel can actually perform their work, they must first study many different user manuals to gain familiarity with numerous virtual control elements and functions.

This approach, which is indeed typical in the industry but is highly inflexible and unsatisfactory, motivated John Deere to seek out a more efficient test method. Test engineers found the solution in CANoe.ISO11783, a development, test and simulation tool from Vector that was precisely tailored to ISOBUS requirements. CANoe.ISO11783 assures ISOBUS conformity in developments: from the initial phases of product development to the test phase and maintenance. The complex ISOBUS communication structures can be analyzed, visualized and prepared in a wide variety of ways. Functions such as the “Virtual Terminal” and “Interactive Task Controller” simplify working with ISO 11783 for the developer. For example, the CANoe Terminal – unlike a real terminal – can be used to simulate different display types, resolutions or black/white settings. The “Interactive Task Controller” lets users load a device description from any real ISOBUS machine, or it can be used to verify simulators before they are used for testing.

Greater test coverage in a shorter time

To preserve their independence from implement producers in testing the Task Controller, test engineers at John Deere especially make use of the tool’s simulation capabilities (Figure 2). Not only can CANoe simulate individual ECUs, it can also simulate entire networks. Developments can only be tested reasonably and
realistically if the later environment is either entirely present or is
generated by rest-of-bus simulation. In the case of the Task Con-
troller, in a wide variety of implement variants can be simulated.
For example, John Deere can act entirely independent of external
manufacturers, and it no longer needs to rely on the physical hard-
ware boxes. A valuable tool for defining automated and recurring
tests is CANoe’s integrated “Test Feature Set”. The system can act
as either the Test Master or be inserted into existing test environ-
ments. Interfaces such as COM or .NET are available for control and
communication with other tools.

The flexibility of the simulations offers considerable relief to
John Deere, as is illustrated by the example of section control: sim-
ulations make it possible to vary the type and sizes of working
machines with little added effort, e.g. to check whether the Task
Controller could handle 16 instead of 8 sections. Implements can
also be defined whose sections are not strictly adjacent, but
instead are offset in back of one another. Since CANoe.ISO11783
represents the standard comprehensively and completely, the agri-
cultural specialist attained a higher level of test coverage in a
shorter amount of time. This was especially true in application situ-
ations that are either unsupported or just partially supported by
the hardware boxes. Such situations include tests intelligent con-
trol of driving speed, checking for correct handshakes or simula-
tion of errors, e.g. when an implement does not signal its readiness
for section control.

At John Deere’s Technology and Innovation Center, CANoe.
ISO11783 not only serves to simulate externally produced work
machines; it is also used for the company’s in-house development
of ECU’s. In testing, either the real tractor hardware can be used, or
it too can be simulated. Since there are sometimes multiple
versions of a Task Controller, each needing to be tested, users can
quickly toggle between different variants to run. CANoe offers
another advantage in distributed development tasks at different
company sites. The simulation configurations can quickly and con-
veniently be exchanged between different departments or even
sent to colleagues in the USA via the company’s intranet or by
e-mail.

**Covering future requirements**

It is no longer reasonable to expect that the complexity of the ISO-
BUS and the variety of implements available on the market today
can continue to be mastered with old, passed-down development
and test methods. Taking their place are development, test and
simulation tools such as CANoe.ISO11783, which provide for the
greatest possible compatibility to the standard in all product phas-
es. The tool’s multibus capability enables troublefree display and
interpretation of ISOBUS and J1939 messages in a Trace Window.
Since the tool covers the full range of ISOBUS functionality and is
always at the latest revision level, John Deere attains better test
coverage at lower expense in terms of time and personnel. At the
same time, the agricultural machine specialist not only has the
ability to test extended Task Controller functions, but to also simu-
late the counterpart device at any time, for the latest and future
developments of the ISOBUS standard.

Interesting in this context is the ISOBUS Multiple Product
Implement Simulator (Figure 3). A multiple-product implement
might be a corn sowing machine with under-root fertilization. It
enables simultaneous sowing and spreading of solid fertilizer. One
of the benefits, besides time savings, is reduced soil erosion,
because the tractor only drives across the field once instead of multiple times. At the time of testing in early 2011, there was still no implement producer that offered such ISOBUS machines on the market. Therefore, it was only possible to have the Task Controller support such machines in a simulation. The full potential of simulations has hardly been exhausted by the basic in-house application. From the perspective of John Deere employees, it would be desirable if manufacturers would exchange their CANoe simulations instead of the inflexible, expensive and difficult-to-reproduce black boxes. The fear that this would somehow reveal internal know-how is unfounded, since it is easy to share the compiled simulations without the source, thereby preserving internal know-how.

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Figures:
John Deere

Links:
Homepage John Deere: www.deere.com
Homepage Vector: www.vector.com

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