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Intelligent technologies in farm machinery manufacture

Microelectronic constructional elements offer new technologies for conducting and planning processes. On-board computers, GPS for use in the mobile sector, comprise new types of aids which lead to new solutions in farm machinery operations. High performance sensors – for instance in image processing – will be future development focal points.

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In the past it has been shown that in the mechanisation of agriculture in industrialised nations different stages with basically different main characteristics are recognisable. In each of these stages an important development takes place which continues in the following stages, but with rather less influence. Based on this, Batel [1] and Matthies [2] proposed a rough division in which four development phases could be differentiated:

- Development of basic systems (up to mid 19th century), improvement of work quality, implements
- Application of energy carriers (up to second half of 20th century), the creation of new work procedures
- Integration of work procedures (from second half of 20th century), creation of new work procedures
- Creation of artificial intelligence (from 21st century), system optimising of work procedures

Presently we find ourselves in another transitional phase. Through the availability of microelectronics new ways in system optimising are being opened-up.

System optimising via microcomputers

The last 10 years have shown that powerful and cost-effective microcomputers play a decisive role in the optimising of work processes. Automation procedures for relieving staff of work, control functions for ensuring quality, the recording and processing of working data on mobile implements and stationary plant, are ideal tasks for microcomputers.

Interface problems

At this point a problem immediately presents itself. Compatibility is required between the different microcomputer-controlled systems, interfaces must be provided. *Figure 1* indicates interactions of the systems in spatially-specific crop production. Although for several years now there have been attempts to unite and standardise these interfaces, only a partial solution exists so far.

For the interface tractor-implement (terminal – job computer), standardisation work has been proceeding for some years.

The agricultural bus system LBS (DIN 8694) defines the interfaces between terminal and job computer as well as those between farm PC and terminal. Even with standardisation work completed since 1999 the LBS standard has not yet established itself as industry norm. Currently, ISO 11783 is being completed. Whilst the physical interfaces for communication job computer – terminal are identical in LBS and ISO, standards the communication protocols between the two differ substantially. Alongside PCMCIA cards, wireless transmission possibilities (infrared or GSM) between farm PC and terminal will increasingly be used [3].

It can be taken, however, that even after the completion of the ISO standard there will continue to be, in the technical realisation of a few manufacturers, individual solutions developed for special presentation and qualification.

Standardised solutions for data exchange between different PC programmes for data management do not exist. Here, software producers depend on agreements between each other so that the farmer can work with programs from different producers.

Positioning per satellite

With the satellite navigation system Navistar (GPS) a very good aid for simple position determination is offered. There are three areas in farming where this can be used:

- Spatially-specific crop production
- Positioning and change procedures in the field
- Organisation of mobile machinery (fleet management)

With spatially-specific management there's a problem regarding the production of application cards. A yield map is not enough for fertilising and plant protection cards. Generally applicable algorithms (expert systems) exist currently only in incomplete versions. New sensors for indirect and, in future, also direct measuring of the nitrogen requirements of plants offer additional support.

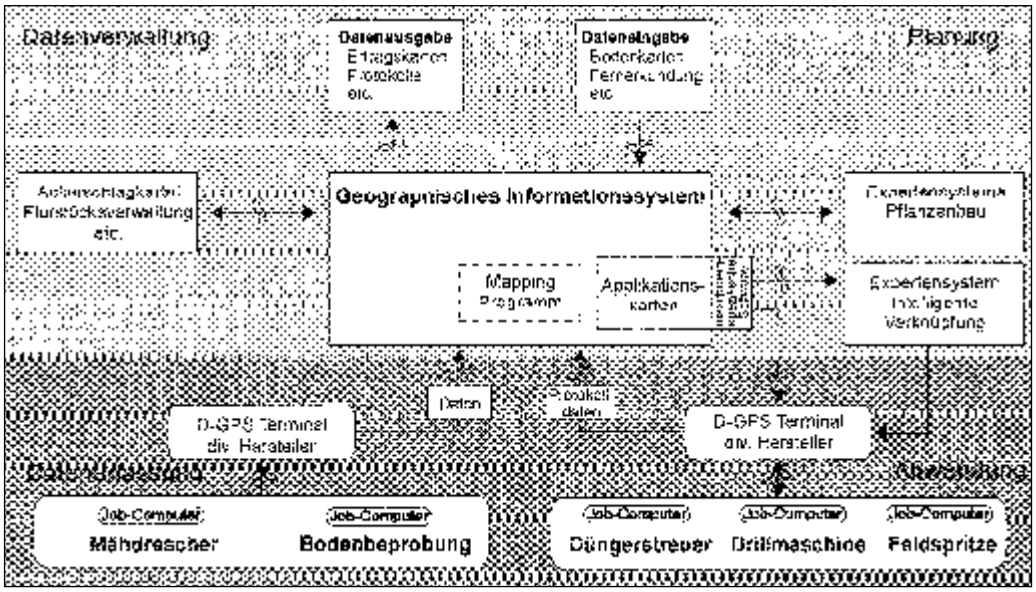

Fig.1: Data processing in site specific crop production

Field position and change procedures require the highest positioning precision. For setting tramlines or exact matching of passes in cultivation and drilling, precision in the range of from 5 cm to 2 m is required, a standard which currently can only be met with very high technical input.

The aim of future development work will be the laying out of machinery and implements so that the predetermined cropping application cards can be optimally applied as far as technically possible. Here it is important that the machinery used also „thinks". In fertiliser spreading to 36 m width and 60 m throw, many situations can occur where precise location determination in itself is not sufficient for regulating application amount or controlling working width. To be considered concurrently is the sector of the application card influenced by the spread fan, where field sensors are, with which direction and speed should be worked and which system-specific time constants apply for application variation. This brings additional requirements for the regulation and control cycle. In the processing computer there must take place real time processing with regard to stored data for the application cards, the momentary determined position data and the machine-specific properties, e.g., an intelligent control of working data [4].

Technical exploitation of Internet

WWW offers a worldwide information source open to all the development possibilities of which are just beginning. Already over 50% of farms have Internet access [5]. The decisive advantage lies above all with timesaving in data and information exchange.

In fertiliser spreaders, drills, and sprayers settings are required for the different operations. These can be done interactively with information, e.g., from Internet.

Various manufacturers offer databanks in Internet where current information is available daily. In future it will be possible to transmit such adjustment information direct to the on-board computer with the machine then reacting automatically. E.g.: Current spreading tables transmission to the on-board computer downloaded from Internet – all settings on the machine can follow automatically without input by the operator.

Technical information regarding the machinery, service indications as well as remote diagnoses are future areas of Internet use, not to mention all the marketing possibilities (spare part procurement, used machinery, offers and advisory input).

Literature

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