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Applying information from automatic process data acquisition

In recent years a system for „automatic process data acquisition on tractor-implement combinations" has been developed based on GPS, LBS and IMI®. With this, continual data on location and time, tractor and implement identification and data relevant to the operation taking place are acquired during work without any input from the operator. Development of databank software for import, analysis and aggregation has created an automated field/machinery and work-time recording system.

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Within the framework of the research project „Information systems for small spatial area crop management" (IKB) the project presented here has been supported by the BMBF. The system was applied at the TU Munich's Dürnast experimental station.

Keywords

Automatic process data acquisition, automated operating data acquisition, IMI, data evaluation

GPS finds increased application in farming. In coming years tractor manufacturers will increasingly integrate LBS as open communication systems under DIN or ISO standards in their machinery. On this technological basis a system for automating process data acquisition can be realised with just a few extra components. Such a system has been developed within the framework of the research project „Information systems for small-area spatial crop management" (IKB-Dürnast) at the TU Munich in the Specialist Department for Crop Production. The information collected by this system formed the data basis for a system for automation of farm data acquisition and also involving processing and evaluation of the data.

System configuration for automatic process data acquisition

The system for automatic process data acquisition with GPS, LBS and IMI® has already been presented at this point in an earlier LANDTECHNIK report [2]. The Global Positioning System (GPS) delivers data on actual position and time. The implement indicator (IMI®) offers implement identification plus important machinery data should the mounted implement itself not have electronic components for identification and for transmission of sensor data. Important process data is continuously delivered from the internal tractor BUS such as speed, pto rpm, and more. A LBS-suitable operator terminal serves implement control and operator information visualisation. Additionally the identification of the operator can be read from the storage medium which is applied for recording the process data (PCMCIA card). All information is accessible to Task Control – an on-board computer [6] programmed through LBS_{lib} via the Agricultural BUS system (LBS). There the data is processed and sent to the recording medium (DOSDRIVE®). The system configuration is presented in *figure 1.*

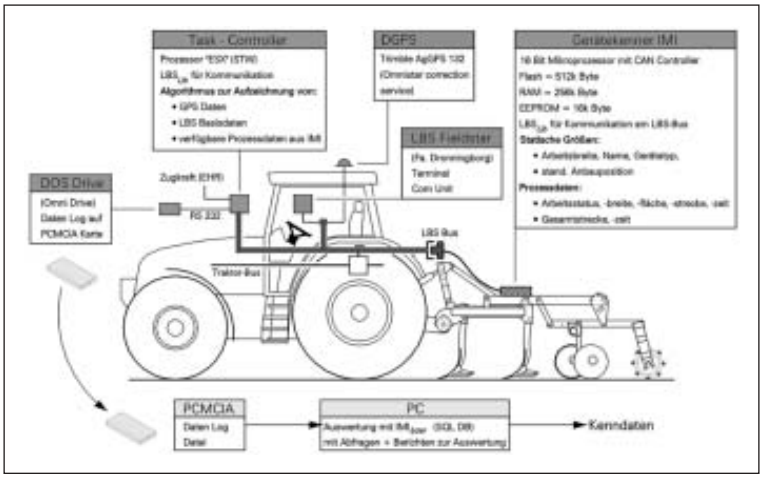

Fig. 1: Configuration of the automatic process data acquisition system [2]

Information content of data from the automatic process data acquisition

The following relevant GPS positioning, operator, tractor and implement data are recorded:

GPS data

- Location coordinates for positioning of data source
- Time stamp for marking time of relevant positions

To enable location identification for data within an area of one to three meters, a differential GPS receiver (DGPS) must be used. The date cannot be delivered from GPS and is taken from the initial operator terminal input.

Date on operator

- Operator's name or ID is applied to the card and asked at system start.

Tractor data

- Description of tractors
- Theoretical and real operating speed
- Engine and pto rpm
- Position of rear hydraulics

• Applied draught power at rear lower links

Implement data

• Description of work/transport implement
• Fixed or variable working width
• Application data (as applied)
• Further sensor data (if available)

The aggregated data applying to main factors for a fertiliser operation carried out with automatic process data acquisition can be taken from *table 1.*

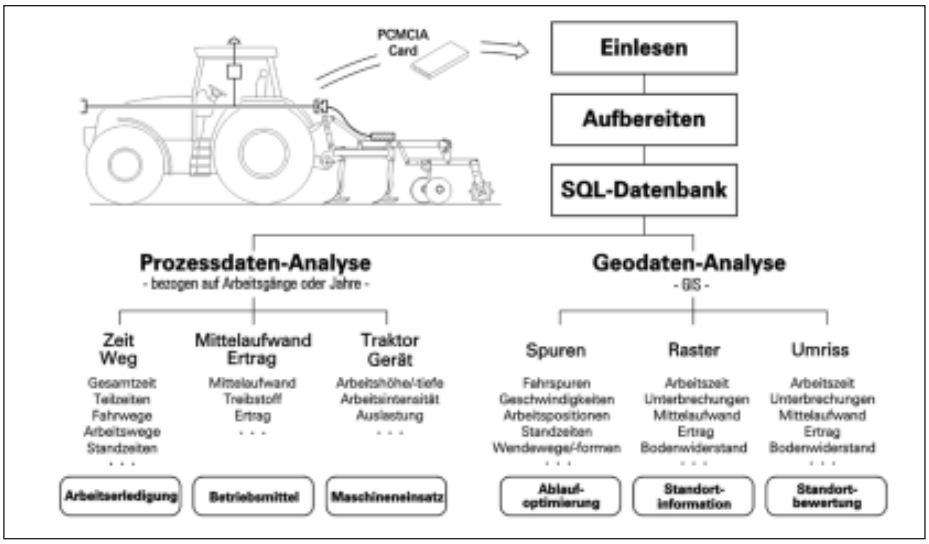

Fig. 2: Process- and geo-data analysis in an automated operating data acquisition system [5]

Application of information for automated operation data acquisition

Data processing through a databank software is absolutely necessary because of the amount of data – a recording frequency of 1 Hz means around 30000 data sets are recorded over an eight hour working day. Only when the analysis and aggregation of the acquired process data regarding relevant operational parameters can to a large extent be automated can one then speak about a system for automation of operational data acquisition. Within a diploma paper, an evaluation software on the basis of MS Access® was developed as a solution [7]. The task of this databank application, called „IMI*lyzer*“, is firstly the import of data into a system of tables for archiving them. Hereby follows a filtering of the data via plausibility test. At this time, the IMI*lyzer* program has been overhauled with the aim of producing a more efficient structure with regard to data storage and access. In the current program version the automatic spatial classification of every individual data set through the received location coordinates and integrated in the area elements within the databank. Herby an attribute is added to every data set with regard to e.g., a specific field or farm. The data stored in this way can now be incorporated into the IMI*lyzer* program and be evaluated with regard to a single operation, a specific field, a certain machine or a single implement. Oversights of the named area are also possible [7]. Through an extension of this software regarding the function of operator-related evaluation and the additional manual inputs for specific fields and machinery-related information there is produced an automatic field, machinery and work file. Interfaces for further data utilisation – e.g. in GIS systems – are also part of the program. Then, in addition to the importance for optimising farm organisation procedures the acquired data is also practical for the channelling of crop management actions *(fig. 2)*. Hereby, the geo-data analysis aids spatially specific management because of the recognizable heterogeneous production potential in a field [1].

Importance of automated operational data acquisition

The automated operational data acquisition allows complete documentation of field-work. In conventional field mapping systems there occurs through the necessity of manual data input information gaps in many cases at this stage – where important data appear in large amounts and at the same time, however, the labour-input requirement is very high. Over and above this, the data acquired through automation has applied high-precision spatial and timely resolutions not possible with manual documentation. The relatively high security against falsification of the involved data means alongside the utilisation for farm manage the system would also be of importance for the assurance of production for processor and consumer as well as for authority checking for environment pollution or reduction of pollution.

Date	Start time	Stop time	Field	Tractor	Implement	Operation
30.04.2001	7.45 pm	8.30 pm	TH01	MB-trac	Prec. spreader	Fertilising

Required on-field time				
Total	Work	Turning	Stand time	Time/area
4,11 km	81 %	19 %	16 %	0,10 h/ha

Distance covered in field			
Total	Work	Turning	Way/area
4,11 km	81 %	19 %	0,71 km/ha

Working speed		Pto rpm work	
Average	standard deviation	Average	standard deviation
9, 26 km	2,27 km/h	450 min^{-1}	61 min^{-1}

Aera fertilised	Amount applied		
Total	Total	Average	stand. deviation
4,75 ha	915,6 kg	203,4 kg/ha	34,9 kg/ha

Table 1: Aggregated informations from fertilizing realised with automatic prozess data acquisition [7]

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