Presenting an idea: log-by-log real-time data transmission from harvester to server over GPRS

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Abstract. Harvesters measure each log individually. Using log by log measurement, data describing each log can be sent individually to customer’s server in real time.

This enables cutting of certain amounts of logs with specified dimensions by several harvesters simultaneously. The amount of logs needed to complete a log lot can be seen from central server. Number of needed logs can be automatically divided between on-line harvesters in bases of better yield or in terms of timber logistics. Suitable amounts of logs can be done to fit with truck loads sizes by several harvesters working jointly in same region. Also significantly better control can be achieved over measurement, calibration and quality issues.

Key words: harvester, logistics, optimisation, measurement, on-line, GPRS

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Introduction

There is an unused technical possibility to add to harvesters an on-line data transmission system to enable faster computer-aided decision making. Since harvesters use timber measurement log by log, the detailed data can be valuable source for optimising cutting work between several harvesters and between stands they work.

Harvester’s measurement system receives dimension data (length and diameter) from its sensors in its cutting head for each individual log cut. It calculates volume for each log and determines log grade according to its measured dimensions, tree species and quality determined by harvester operator. Log volumes are summed by diameter classes, species and quality classes to form a summary sheet. The sheet can be sent via GPRS connection to office computer and/or printed out. The sheet is basis for subsequent decision making as well as payment calculations.

The idea

In order to achieve on-line data system for better and faster decision making, the data describing cut logs must be sent to central server in real time log by log. Having detailed data over log assortment being cut by several harvesters simultaneously in separate stands, the produced assortment can be automatically optimised in terms of logistics, time consumption for its production and outcome of needed log sorts from different stands. The on-line data system creates also better control possibilities over timber measurement with harvester.
Material and methods

Technical solution
Log by log data must be sent from harvester computer to server before they are summed. Each harvester must write data to its own database in the remote server. In other words: descriptive data of each log must be in server’s database immediately after log has been cut. This solution needs continuous internet connection between harvester and central server. It can be achieved via GPRS connection. If needed, an external antenna or special GSM car equipment can be installed to compensate weak signal in forest or on hilly terrain. In the case of short interruptions of signal data must be stored and sent all together after regaining signal. The GPRS connection type is taxed only on bases of data flow. While capacity of data sent is very small, the cost of it is almost unnoticeable.

The database
The database must be in a form of numbers and text with delimiters in order to be as small as possible. The database must be accessible for writing into it only for harvester computers. Other interested parties should have only password protected access for reading data.

The database must contain following data fields:
1. Length of the log
2. Top diameter of the log
3. Quality class of the log (including tree specie symbol)
4. Volume of the log
5. Number of the log*
6. Time when log was cut from stem (hours, minutes, seconds)*

*The 5th and 6th data field are needed to enable quick control procedure over measurement.

Results

Optimisation
There is a possibility using several harvesters working simultaneously in different stands to produce certain amount of specific logs in minimum time. For example an amount of logs with specific dimensions are needed for building log houses. The online database enables to analyse which amount of the specific logs each harvester can produce in a time unit while working in an individual stand. Then the amount of the logs needed to cut can be shared optimally among harvesters. This creates situation when all harvesters finish cutting of the specific log lot almost at the same time and customer can get the lot in minimum time possible.

Volumes of produced timber lots can be known much earlier compared to present system. There is an advantage of knowing sizes of timber lots before they are transported from cutting area to road side. The time span that remains between cutting and transporting timber to road side can be used for optimisation of its transport. Logistic companies have more time to optimise their transport schedule. It also reduces the time that timber lot must stay stacked at road side. Shorter period from cutting to industry enables fresher timber and its higher quality.

Logistic companies can offer their transport proposals for log lots in terms of transport time and price. Then the best offers can be selected by the timber owner to reduce direct costs as price of transportation and indirect costs as probable loss of timber quality during longer storage.
According to transportation schedule, the forwarder operator can bring to road side first the log sort that can be transported away first. Making rough estimation how much timber has been brought already to the road side remains the task of forwarder operator.

Positions of future and present timber lots must be seen to logistics companies from suitable web-based map application.

Simplicity in monitoring timber harvesting process enables enhancing data acquisition for forest certification.

**Better control over measurement**

Second possibility to get use of the on-line data system is achieving better control over cutting process, especially over log data. Having better control over cutting process may be in interest of all parties in timber measurement and production.

As long as harvester operator has control over measurement data, there are some sources of misuse trust. Following some possible misuse schemes of harvester measurement:

1. It is possible to save measurement data of one cutting area to different files and show only one of the files as result of measurement (that means to hide some amount of timber harvested). While measurement by harvester is the basis of price calculation in buying - selling contract, the possibility of hiding measurement files can be source of theft.

2. Harvester operator can give low quality class (fuelwood class) for amount of logs (truckload) with really good quality. Following logs with good quality must be replaced with truckload of fuelwood at roadside. Price difference of log lots with same size is the objective of theft.

3. Summary sheet of cut logs can be falsified lifting number of cut logs on falsified sheet to lower diameter classes. Calculating log volumes for smaller diameters false measurement sheet is completed. Amount of timber between original and false summary sheet is target of theft.

On-line data transmission that can be controlled by interested parties of timber contract eliminates sources of theft. For having control over measurement interested parties must have access with limited rights (read only) to the on-line database where measurement data are stored. The access may be also limited with password that is given to contract parties.

Database must be reached from cutting area through lap-top computer that has GPRS connection through mobile phone or special GSM-GPRS card inserted to computer. It is also possible to access the database through a mobile phone that has web browser.

Person who controls harvester measurement goes to the cutting area, opens the database in web browser during harvester operation and ensures if data rows are continually added to database when logs are cut. Being sure that measurement data is stored to database the logs dimensions can be controlled to make sure they are the same as in database. Also logs tree species and qualities fit with database can be controlled.

Cut logs can be control-measured on cutting area without stopping harvester operations. The control measurement can be done when the harvester has reached to safe distance from the logs intended to control. Control measurement can be done for controlling or for calibration purposes.

Logs for calibration and controlling can be chosen randomly by random number generator like on sawmill measurement lines. Logs must be randomly chosen after
harvester operator has given quality class for the log and pushed cut-off button to cut log from stem.

The randomly selected control logs must be automatically marked by harvester with colour stripe(s) to enable to find them from the rest of the logs on the cutting area.

Logs for calibration can also be randomly selected or cut and laid on the ground in sequence. Also colour marking of the calibration logs in sequence eases finding them by the measuring person. Data describing the selected logs for calibration or control must be sent in two formats. The first format is described above in section “The Database”. The second format must be the same that is used to transfer calibration data to electronic calliper (log diameters after each meter) (Hakkuukonemittaus..., 2006). In traditional calibration procedure data is loaded through cable while cutting operations are stopped. Sending calibration data from harvester to measurer and back to harvester with control results can be sent via GPRS-connection automatically without slowing harvester operation.

In order to have control over harvester’s measurement and enable automatic arrangement of log data by their properties, the database collected into server, must contain in addition to log description (dimensions and quality) also following data fields:
1. Number of the log
2. Time when log was cut from stem (hours, minutes, seconds)
   General description of cutting work as date, place and the name of harvester’s operator must be available in connection of the database file.

Discussion

If the harvester is not equipped with colour marking device the controlling person must observe and remember locations where the logs intended to control were put by the harvester.

There may be problems with visually matching logs cut with their descriptions in database when there is low speed of data transmission between harvester, server and hand-held computer (or mobile phone with web access). In the case of low speed of data transmission when data rows are seen by the controlling person with some significant time span there must be another possibility to distinguish logs in the database. A log is matched with its description in database by exact cutting time value that is added to log data when the log is cut.

When the clock in harvester computer does not keep exact time, the GPS based or DCF radio controlled time must be used instead of it to create time values into the database. Also the controlling person must have access to GPS based or DCF radio controlled time.

During the controlling operation the controlling person writes down the exact times when logs intended to control are cut and adds their descriptions to enable to find them later out of other logs. Also descriptions of where the logs were put may be written down to find them more easily.

For finding unmarked logs for control measurement bases on the idea that control logs must be with significantly different properties in order to distinguish them later from the mass of logs lying on the ground. The different properties are: small or big diameter, short or long length, different tree specie and different quality.

Files describing calibration settings must be sent automatically via on-line connection when calibration has been done and calibration settings changed. The cali-
bration files must be sent in separate files from ordinary measurement data flow. The files must contain both measurement results: with harvester and with electronic calliper. The results must be compared and measurement differences calculated. The files are needed to enable to check if there has been measured statistically sufficient number of control logs based on their variation of dimensions differences (Hakkuukonemittaus…, 2006).

All calibration or control measurement files must be sent to server automatically regardless if calibration settings have been changed or not. The files are needed to prove to interested parties that measurement accuracy is systematically kept under control.

Information about the harvester technical readings like oil pressure, temperature etc. can be sent on-line to its service company to enable monitoring of possible disorders to predict automatically probable future failures. Also owner of the harvester can control any time from distance if the harvester is operated properly in technical terms.

Using the control system supposedly reduces real need for control activity. The lasting possibility that control operation can be done any time unnoticeably from distance keeps harvester’s operator’s discipline high.

Conclusions

The on-line data transmission system is on the idea stage at the moment. To go further with developing the idea, special software for receiving server and for harvester computer must be worked out.

Several tests must be carried out to check the system.

1. Software must be tested on simulated data and in real situations in forest, for example in weak signal conditions.

2. Optimisation possibilities must be tested to analyse possible benefits from simultaneous cutting of a log lot.

3. Tests must be carried out on possibilities of making calibration and control measurement without stopping harvester - by using GPRS-based both direction data transmission. Random selection of control logs with their automatic marking and later recognising of the logs must be also tested. Typical calibration procedure where control logs are made in sequence must be carried through to test how much the on-line data transmission gives advantage in saving time.

There is need to investigate the on-line data transmission in terms of economy. The achieved benefits must be compared in monetary terms with cost of developing the system.

References


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