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Content

Environmental research includes field studies where highly fluctuating, not controllable parameters are to be monitored. For this application the use of sensors that communicate using wireless local network and long range communication between data loggers and PC via internet link is particularly attractive. A prototype data collection system has been developed, primarily for agricultural odour research taking advantage of the technological progress.

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IT-Based Automatic Sampler for Agricultural Odours

The rapid development of IT and electronic technologies has opened new possibilities for development of less expensive and more advanced system to collect data and samples than before. At DIAS, Department of Agricultural Engineering a prototype of the system has been developed as a subproject of the project “Odour from animal production facilities”. The new system is called IT-Based Automatic Sampler (ITBAS), which is an intelligent and flexible module-built system that can be easily adjusted to different measuring and sampling tasks in laboratories, in open fields for environmental studies and in livestock buildings.

ITBAS aims at collecting and mapping odorous nuisances from agriculture under different conditions. ITBAS consist of a number of sensor and thermal desorption tube (STD) units, sensor units, weather stations and a base station, ref. Figure 1. The thermal desorption (TD) tube contains different absorbents to absorb the odour molecules when an air sample is passing through it. In the laboratory, the TD tube is heated to a high temperature so that the absorbed odour molecules are released to a carrier gas, which brings them to gas chromatography and mass spectrometry (GC/MS) where quantity of the different molecules are detected.

The focus of this development is on sampling by using TD tubes from the air of livestock buildings, but it could be adjusted to other purposes, e.g. collecting odour samples in bags for olfactometer analyses, aerosols for studying airborne contaminants.

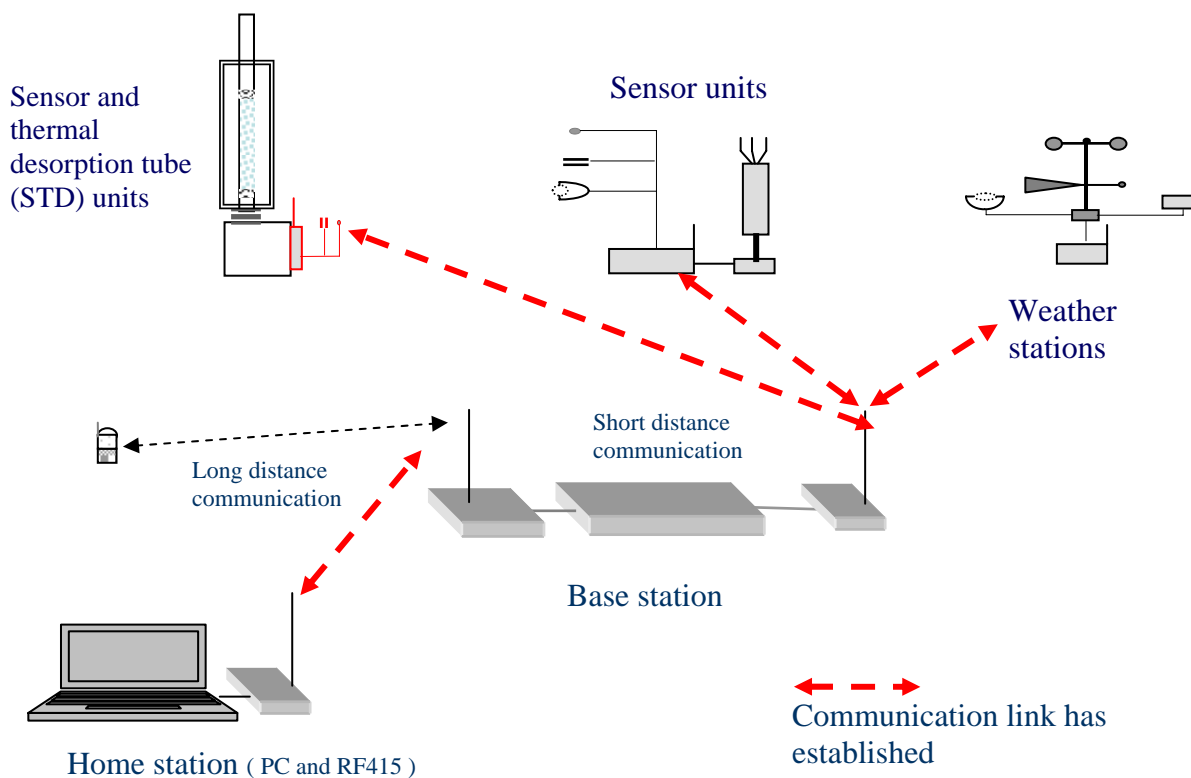


Figure 1. IT-based Automatic Sampler (ITBAS). A battery driven wireless system, which can automatically collect odour samples and information related to odour emission, transport and immission

The system concept

ITBAS is a battery driven wireless module-built system based on the programmable data loggers supplied by Campbell Co. Ltd, UK and long distance MM2M™ communication system supplied by Delta Danish. The base station is capable of short distance (less than 2 km) communication with other units via Campbell RF415 (2.4 GHz). It downloads and treats the data from the STD units, sensor units and weather stations. The base station decides the time of the sampling by help of a program and sends a control signal to the STD units, which sample odour samples according to the programmed procedure. The base station can also communicate (encrypted) via the Internet by help of the MM2M-system, which is using virtual private network (VPN) and general packet radio service (GPRS), with home station and mobile telephone any where in the world.

Status

The short distance communication between base station and STD units, sensor units and weather stations has been established and tested. A reliable and safe long distance communication link between the base station and the PC home station has been established and tested.

Figure 2 shows the STD unit consisting of a programmable data logger (Campbell CR215), temperature and humidity sensors, air pump, flow meter (Honeywell), electronic module and battery. To prevent possible moisture condensation in the TD tube, an electric heating element that can keep the TD tube 10°C above (adjustable) the ambient temperature is mounted around the TD tube.

Sampling duration is depending on the gas concentration at the sampling point, the sampling rate and the detection limit of the analytical method, i.e. GC/MS. The preliminary results show that sampling duration around 10 minutes is suitable for evaluation of odour emission, transport and immission under a relative stable weather condition; but inappropriate under a fluctuating condition.

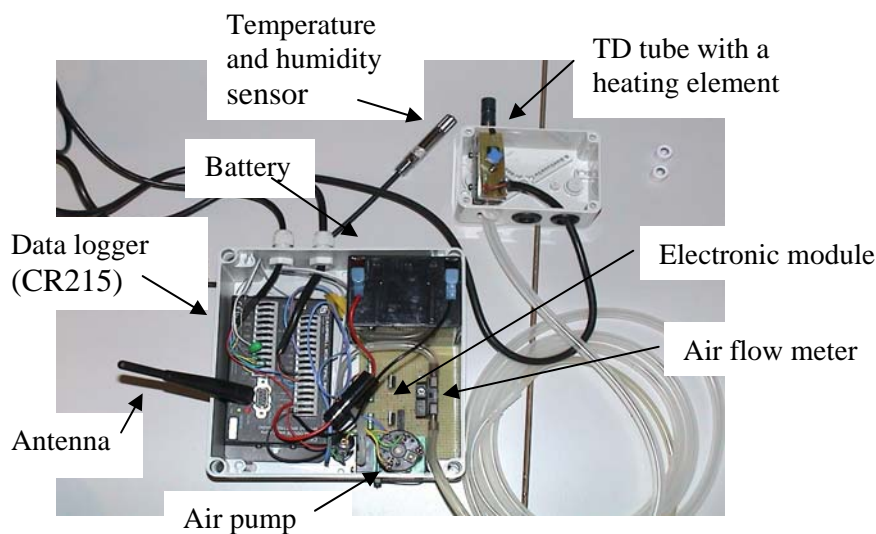


Figure 2. Sensor and Thermal Desorption tube unit (STD-unit)

Further work

A 3-D ultrasonic velocity sensor will be evaluated for information about the wind and the air movements to estimate the odour transport around the sampling point. A series of field surveys will be carried out and the results analyzed. If successful a program to decide the time of sampling will be developed to include the data from the 3-D velocity sensor. The other parameters that will be included in the program are distance from the odour source, wind direction and velocity around the source, solar intensity, humidity, temperature gradient around the sampling point, date and time of the day.

The prototype sensor system is presently further improved and used to gather odour and related information as part of the project “Absorption in water droplets of odours, ammonia and dust from livestock buildings”.

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Topics of coming newsletters

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Single plant spraying

Portraits of Ph.D. students in the area of agricultural engineering and technology

