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NIR on the Go, Padova, Italy, 27–28 May 2010

Pierre Dardenne
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The first conference which we can call "NIR on the Go" was organised by Dr Christian Paul (FAL, Germany) and held on 24 June 2003 in Asendorf, Germany. Christian thought that a special interest existed in this field and he was right, considering the success of the subsequent conferences on this topic. The following year, we held the second conference in November 2004 in Gembloux, Belgium.[1] For the third, Christian again received more than 100 participants in Braunschweig, Germany for the meeting held on the 12–13 June 2007 just before the 13th ICNIRS conference in Umea, Sweden. Deeply involved in "NIR on the Go" applications, Dr Paolo Berzaghi from the Department of Animal Science, Padova University (Italy) undertook the responsibility for organising the fourth "NIR on the Go" conference in his own town of Padova. Paolo received the support of his university and we were warmly welcome in a very comfortable auditorium in the middle of the green "Agripolis" campus.

The meeting started on Thursday 26 May with an afternoon workshop at which Dr John S. Shenk and John W. Shenk (SA-I, Shenk Analytical International, LLC, USA) presented their new software package. Under the general name of Unistar®, Ucal, Uscan and Unet are the three main modules for calibration development, routine prediction and internet monitoring, respectively. John S. insisted on the importance of the constituent data base structure and his new condensing method which removes redundant information and allows enhancement and recalibration in a very efficient way. The package has been commercialised by Unity Scientific but the prediction engine is able, in routine mode, to predict spectra acquired by other instruments.

On the 27th, the first invited speaker in the "hardware" session, Dr Dave R. Mertens, USA [Mertens Innovations LLC (previously USDA)] gave a lecture demonstrating the impact of daily measurement of feed on milk production and thus on net commercial benefit. He concluded, "These observations suggest that precise feeding of dairy cows

John Shenk presenting with Paolo Berzaghi.

can decrease losses in production due to uncontrolled changes in the ration and that on-farm NIR technology can provide DM results reliably and quickly enough to make daily adjustments in rations."

Dr Piet Reyns, NI (Limagrain Nederland BV) reported the results of a large experiment in which 600 wheat and 300 barley samples were scanned on five diode array instruments. The *RMSECV*s were significantly different and it was shown that the instruments providing information up to 2010 nm or 2110 nm produced results which were worse than the classical DA range up to 1700 nm.

Dr L. Urbonas (Polytec Gmbh, Germany) described the flexibility of their spectrometers, sensor heads and software which could be adapted easily to face with any online situation.

Dr David Honigs from Perten Instruments Inc, USA, gave an interesting talk about instrument resolution and data point spacing. With an example, he demonstrated that a 16 nm wavelength spacing calibration was

just as good as those obtained using 2, 4, 6 or 8 nm spacing. In other words, collecting data at 0.5 nm intervals with an instrument having a 10 or 12 nm optical resolution does not give more information. "Like the Michelson interferometer, any given optical resolution requires two data points per resolution element".

The second invited speaker was Dr Lars Munk, Spectroscopy and Chemometrics Group, University of Copenhagen, Denmark. The content of his lecture was astonishing, especially when he mentioned the scanning and sorting into three grades of 20,000 wheat kernels/second! A spin-off of his group called Bomill TriQ (www.bomill.com) has developed industrial equipment able to sort two tons of wheat per hour based on single kernel measurements. It was a little bit frustrating not to get more information on the NIR sensor and on the unsupervised method able to perform the classification (a patented method!) but the topic is surely at the cutting edge of technology.

The organising team from back-left: Roberto Riovanto, Paolo Berzaghi, Jacob Karlen, Pierre Dardenne, Jacopo Ferlito, David Mertens, Phil Williams, Francesco Benozzo, Massimo Mirisola, Christian Paul.

Within the same topic, Christian Moschner (Institute of Agricultural Engineering, Christian-Albrechts-University, Kiel, Germany) presented manure analysis for DM, total N, NH_4, P and K using the Polytec diode array instrument directly installed on the main pipe below the spreading tank. Validation *RPD* values were between 2.2 and 5.40.

Dr Helga Andree (m-u-t AG, Wedel, Germany) presented their multiplex DA instrument to analyse organic dry matter (OMD) of the input matter (corn silage) and of the biogas substrate in a biomethanisation plant. This lecture was complete and very well done. Helga received the prize for best oral lecture, sponsored by CAMO with a two-year license for the Unscrambler X.

Just after the last session of the day, we left Legnaro and the university campus to enjoy the gala dinner at the Galileo Hotel in Padova. Italian food is very well recognised and all the participants appreciated *primi*, *antipasti* and *secondi* courses as well as the wine! Lunches at the university restaurant were also very nice and made some participants a little bit sleepy during the afternoons!

On Friday 28th, the application session continued with Dr Wilfried Wenzl (Raumberg-Gumpenstein, Austria) who presented an interesting alternative for the analysis of manure and biogas substrates. Everyone knows that high moisture products are difficult to analyse by NIR, especially for minerals at low concentrations. The idea proposed was to catch the material on a zeolite compound which absorbs all of the nutrients. After drying, the powder can be scanned on a spectrometer. In this way, even NH_4 can be assessed by NIR with good accuracy. The technology is patented and commercialised under the name NIRS-Nanobag.

Coming from the University of Wisconsin (Madison, USA), Jacob Karlen detailed experiments to set up the calibration and validation for the daily measurements of silage dry matter in bunker and tower silos based on a DA instrument (Deere & Co, Moline, IL, USA). This work formed the basis of the Mertens conclusions given during the first session.

A little bit out of scope but interesting and well presented was the lecture of Anna Sandak (Trees and Timber Institute, San Michele all'Adige, Italy). NIR was demon-

Starting the second session about software, the German team of Heinrich Prüfer (Sensogic Gmbh) and Peter Tillman (VDL-UFA) presented the software requirements for online applications. Due to high data rates and large numbers of spectra, software must integrate high speed filtering and pre-processing. The hardware connectivity is important, including GPS. The calibration must be easily updated and subset selection is needed to avoid redundancy in the wet chemistry cost.

Dr Pierantonio Facco, University of Padova, reported experiments to test six transfer methods of wet forage calibrations between four AgriNIR DA instruments. Five of the methods gave quite similar results with a slightly advantage for the PDS method.

The third session, "Applications", started with Dr Georges Sinnaeve, CRA-W (Belgium) who briefly presented some different applications developed by the CRA-W NIR team: apple sorting, apple orchard handheld measurements, sugar beet seed protection checks, cow milk analysis at the milking station, textile sorting, fermentation monitoring (starch to glucose and ethanol, yoghurt, *Streptococcus pneumoniae*, VFA in biomethanisation) and embedded NIR DA instruments on harvesters for forages and cereals. Georges finished with the view of a new, pushbroom hyperspectral camera

(Burgermetrics) which will be used, among other things, for online wheat contaminant detection.

Dr John S. Shenk presented his new hardware development; a light, portable and low cost spectrometer for farm and field applications (forages, cereals, TMR, feed ingredients etc.). The unit includes a head sensor with the lamp, an optical fibre connected to the spectrometer and a microcomputer. The diode array covers the classical range 900–1700 nm and the performance is similar to laboratory equipment. The prediction engine is based on the new Unistar package. At 77, John is still very creative and enthusiastic to accomplish his mission for NIR promotion and has finally reached what his grandfather asked him to do 60 years ago; evaluate quickly the feed lots to increase milk production! He told us the story! Mission accomplished!

Dr Phil Williams (PDKprojects, Inc., Canada) presented on-site and on-line pig manure analysis with a diode array instrument. By way of background, Phil explained why it is important to know the fertilising value of manure spread on a field. In one reservoir, the total solids and the mineral composition (N, P, K) are highly-variable and only continuous measurements are suitable to obtain accurate values. The measurements are done when the pan is emptied.

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strated as an efficient tool to recognise the origin of spruces.

Alberto Barbi (Dinamica Generale srl., Italy) presented a totally new idea; the DA instrument is placed directly in the bucket of a front loader and the material (grass and corn silage, ingredients etc.) are automatically analysed when the mixer wagon is loaded. Alberto explained also the interconnectivity with their mixing package. A change in the dry matter content of a sample will immediately alter (through a wireless connection) the total quantity of the given material according to the ration formula. Dinamica Generale are also producing a portable NIR analyser (www.dinamicagenerale.com).

The last lecture was given by Dr Christian W. Huck (Leopold-Franzens University, Innsbruck, Austria) and concerned nanomaterial characterisation using FT-NIR; a fascinating world but a little mysterious for most of the agronomists in the audience.

All the lectures were followed by active discussions, revealing the interest and enthusiasm for this subject. There were also a dozen posters and the best was attributed to Eduardo Zamura-Rojas for his work using a portable NIR instrument (Phasir 2400) to discriminate pig carcasses according their feed rations. Eduardo received also a two-year license from CAMO.

Forage analysis with the AllStar R1630 from Shenk Analytical International LLC.

On Friday afternoon, Paolo led us on a visit to the old building of the university where he had himself received his degree. The building is very remarkable and if you have the opportunity to visit, the place is worth a detour. Just a little bit before Paolo, Galileo Galilei was the most famous teacher there. Andreas Vesalius (born in Brussels in 1514) held the chair of Surgery and Anatomy (*explicator chirurgiae*) at Padova University and in 1543 published his anatomical discoveries in *De Humani Corporis Fabrica*. This book triggered great public interest in dissections and caused many other European cities to establish anatomical theatres. The original anatomical theatre is still there to visit in Padova. The university is also famous because it is the first

university in the world to give a degree to a woman. Elena Lucrezia Cornaro Piscopia was a Venetian mathematician of noble descent and the first woman to receive a Doctorate of Philosophy degree on 25 June 1678. What progress!

All the comments I received from fellow attendees were positive and the 80 participants left Italy satisfied with the meeting and the country. On behalf of everyone, I would like to thank again Paolo and his team for their friendly hospitality and for the quality of the organisation and the lectures. I would like also to thank especially Dr Christian Paul; even though retired from FAL, he is still very involved in NIR development and contributed a lot to the success of the meeting. The sponsors are also gracefully acknowledged; GraiNit, Sensologic, Dinamica Generale, Haldrup, M-U-T AG, AMS, Zeiss, Vdlufa, Polytec and Camo. Abstract book and presentations are or will be available at this address: http://www.nironthego2010.it

We are now waiting for candidates to hold the next "NIR on the Go" conference. Anyone is invited to send information about to the "informal" committee of "NIR on the Go" — Paola Berzaghi, Christian Paul or myself.

Reference

1. C. Paul, "Embedded near infrared goes to the fields", *NIR news* **16(2),** 3–4 (2005).