

Table of contents

Editorial	19
Section 1 - Remote sensing	21
Active sensing of the N status of wheat using optimized wavelength combination: impact of seed rate, variety and growth stage <i>J. Jasper, S. Reusch and A. Link</i>	23
Development and first tests of a mobile lab combining optical and analogical sensors for crop monitoring in precision viticulture <i>F. Mazzetto, A. Calcante, A. Mena and A. Vercesi</i>	31
Sensitivity of narrow and broad-band vegetation indices to leaf chlorophyll concentration in planophile crops canopies <i>M. Vincini and E. Frazzi</i>	39
Comparison of methods to estimate LAI from remote sensing in maize canopies by inversion of 1-D and 3-D models <i>R. Casa, S. Pascucci, A. Palombo, G. D'Urso, A. Maltese, G. Ciraolo, L. Giordano, R. Lopez-Lozano, F. Baret and H.G. Jones</i>	47
Using GreenSeeker® to drive variable rate application of plant growth regulators and defoliant on cotton <i>G. Vellidis, B. Ortiz, G. Ritchie, A. Peristeropoulos, C. Perry and K. Rucker</i>	55
Canopy temperature interpretation of thermal imagery for crop water stress determination <i>M. Meron, J. Tsipris, V. Alchanatis and Y. Cohen</i>	63
Using an active sensor to make in-season nitrogen recommendations for corn <i>J. Schmidt, R. Sripada, D. Beegle and A. Dellinger</i>	71
Optical signals of oxidative stress in crops physiological state diagnostics <i>E.V. Kanash and Y.A. Osipov</i>	81
Spatial patterns of wilting in sugar beet as an indicator for precision irrigation <i>L. Zhang, M.D. Steven, M.L. Clarke and K.W. Jaggard</i>	89
Development of an instrument to monitor crop growth status <i>M. Li, D. Cui, X. Li and W. Yang</i>	97
Field hyperspectral imagery: a new tool for crop monitoring at plant scale <i>N. Vigneau, G. Rabatel and P. Roumet</i>	105
Determination of canopy properties of winter oilseed rape using remote sensing techniques in field experiments <i>L. Engström, B. Lindén, M. Söderström, T. Börjesson, K. Nissen, N. Lorén, I. Gruvaeus and O. Hagner</i>	113

Within-field and regional prediction of malting barley protein content using canopy reflectance	119
<i>M. Söderström, T. Börjesson, C.G. Pettersson, K. Nissen and O. Hagner</i>	
Development and improvement of air-assisted seeding for paddy field following map information	127
<i>T. Chosa, M. Furuhashi, M. Omine and R. Sugiura</i>	
Improved modeling of maize growth by combining a biophysical model of photosynthesis with hyperspectral remote sensing	133
<i>N. Oppelt and T. Hank</i>	
Comparing hyperspectral vegetation indices for estimating nitrogen concentration of winter wheat	141
<i>F. Li, Y. Miao, S.D. Hennig, M.L. Gnyp, X. Chen, L. Jia and G. Bareth</i>	
Possibilities of cereal canopy assessment by using the NDVI	151
<i>J. Křen, V. Lukas, I. Svobodová, T. Dryšlová, P. Míša and L. Neudert</i>	
Evaluation of palm trees water availability using remote thermal imaging	159
<i>Y. Cohen, V. Alchanatis, A. Levi, V. Soroker, A. Prigojin and Y. Cohen</i>	
Section 2 - Biomass other than remote sensing	167
Use of ultrasonic transducers for on-line biomass estimation in winter wheat	169
<i>S. Reusch</i>	
Use of a ground-based LIDAR scanner to measure leaf area and canopy structure variability of grapevines	177
<i>J. Arnó, A. Escolà, J.M. Vallès, R. Sanz, J. Masip, J. Palacín and J.R. Rosell</i>	
Sensing tree canopy parameters in real time for precision fructiculture/horticulture applications: methodology set-up and first results	185
<i>A. Escolà, J. Arnó, R. Sanz, F. Camp, J. Masip, F. Solanelles, J.R. Rosell and S. Planas</i>	
Test of a high-end laser rangefinder scanner in agriculture	193
<i>D. Ehlert, M. Heisig and R. Adamek</i>	
Section 3 - Plant disease	201
Determination of head blight on ears of winter wheat by means of hyperspectral and chlorophyll fluorescence image analysis	203
<i>E. Bauriegel, H. Beuche, K.-H. Dammer, A. Giebel, W.B. Herppich, J. Intreß and B. Rodemann</i>	
Early detection of <i>Puccinia triticina</i> infection in susceptible and resistant wheat cultivars by chlorophyll fluorescence imaging technique	211
<i>K. Bürling, M. Hunsche and G. Noga</i>	
Detection of the Tulip Breaking Virus (TBV) in tulip using spectral and vision sensors	219
<i>G. Polder, G.W.A.M. van der Heijden, J. van Doorn, R. van der Schoor and A.H.M.C. Baltissen</i>	

Investigation into the classification of diseases of sugar beet leaves using multispectral images <i>S.D. Bauer, F. Korč and W. Förstner</i>	229
Spectral signatures of diseased sugar beet leaves <i>A.-K. Mahlein, U. Steiner, H.-W. Dehne and E.-C. Oerke</i>	239
Section 4 - Sensing plant characteristics	247
Plant leaf roughness analysis by texture classification with generalized fourier descriptors in a dimensionality reduction context <i>L. Journaux, M.F. Destain, F. Cointault, J. Miteran and A. Piron</i>	249
Evaluation of cost-effective real-time slope sensing system for wild blueberry <i>Q.U. Zaman, A.W. Schumann, K.C. Swain, D.C. Percival, M. Arshad and T.J. Esau</i>	257
Intelligent autonomous system for the detection and treatment of fungal diseases in arable crops <i>D. Moshou, C. Bravo, R. Oberti, L. Bodria, S. Vougioukas and H. Ramon</i>	265
On-the-go yield and sugar sensing in grape harvester <i>E.M. Báguena, P. Barreiro, C. Valero, X. Sort, M. Torres and J.M. Ubalde</i>	273
MARVIN: high speed 3D imaging for seedling classification <i>N.J.J.P. Koenderink, M. Wigham, F. Golbach, G. Otten, R. Gerlich and H.J. van de Zedde</i>	279
Flower spatial variability in an apple orchard <i>A.D. Aggelopoulou, D. Bochtis, A. Koutsostathis, S. Fountas, T.A. Gemtos and G.D. Nanos</i>	287
Apple detection in natural tree canopies from multimodal images <i>J.P. Wachs, H.I. Stern, T. Burks and V. Alchanatis</i>	293
Effects of seed rate and nitrogen fertilisation on cereal canopy characteristics <i>J. Křen, I. Svobodová, T. Dryšlová, P. Miša and L. Neudert</i>	303
Section 5 - Sensing weeds	311
Classification of sugar beet and volunteer potato reflection spectra using a neural network to select discriminative wavelengths <i>A.T. Nieuwenhuizen, J.W. Hofstee, J.C. van de Zande, J. Meuleman and E.J. van Henten</i>	313
Automated weed detection in winter wheat by using artificial neural networks <i>A. Kluge and H. Nordmeyer</i>	321
Development of an integrated approach for weed detection in cotton, for site specific weed management. <i>R. Efron, V. Alchanatis, Y. Cohen, A. Levi, H. Eizenberg and U. Shani</i>	329
Selectivity of weed harrowing with sensor technology in cereals in Germany <i>V. Rueda-Ayala and R. Gerhards</i>	339

Automatic derivation of weed densities from images for site-specific weed management <i>M. Weis and R. Gerhards</i>	349
Assessment of a ground-based weed mapping system in maize <i>D. Andujar, A. Ribeiro, C. Fernandez-Quintanilla and J. Dorado</i>	355
Evolution of agricultural machinery: the third way <i>M. Berducat, C. Debain, R. Lenain and C. Cariou</i>	363
Section 6 - Yield monitoring and ICT	371
Mass flow sensor for combines with bucket conveyors <i>R.S. Zandonadi, T.S. Stombaugh, D.M. Queiroz and S.A. Shearer</i>	373
Automated, low-cost yield mapping of wild blueberry fruit <i>K.C. Swain, Q.U. Zaman, A.W. Schumann, D.C. Percival, D. Nams and T.J. Esau</i>	381
Development and first tests of a farm monitoring system based on a client-server technology <i>F. Mazzetto, A. Calcante and F. Salomoni</i>	389
Agri yield management: practical solutions for profitable and sustainable agriculture based on advanced technology <i>J. Hadders, J.W.M. Hadders and P. Raatjes</i>	397
Flow behaviour analysis of a RFID-Tracer for traceability of grain <i>U. Steinmeier, D. von Hoersten and W. Luecke</i>	403
Section 7 - Soil sensing and interpretation of variability	413
On-the-go measurement of soil gamma radiation <i>E.H. Loonstra and F.M. van Egmond</i>	415
Combined sensor system for mapping soil properties <i>H.S. Mahmood, W.B. Hoogmoed and E.J. Van Henten</i>	423
Reproducibility of different composite sampling schemes for soil phosphorus <i>M. Schirrmann, H. Domsch, U. von Wulffen, J. Nieter and O. Zauer</i>	431
The capability of non-destructive geophysical methods in precision agriculture to capture subsoil mechanical strength <i>G. Hofer, E. Lück, V. Gundelach, J. Rühlmann and J. Bachmann</i>	439
Comparison of different EC-mapping sensors <i>E. Lueck, U. Spangenberg and J. Ruehlmann</i>	445
Comparison of directional semi-variograms for mouldboard plough and field cultivator draught <i>N.B. McLaughlin, S.D. Burt and D.R. Lapen</i>	453

Mapping traffic patterns for soil compaction studies using GIS <i>A.D. Meijer, R.W. Heiniger and C.R. Crozier</i>	461
Searching for the cause of variability <i>J.N. Jukema, K.H. Wijnholds and W. van den Berg</i>	469
Delineation of site-specific management zones using geostatistics and fuzzy clustering analysis <i>A. Castrignanò, F. Guastaferro, D. De Benedetto, A. Moneta, B. Basso, A. Troccoli and M. Pisante</i>	477
Mapping spatial variation in growing willow using small UAS <i>A. Rydberg, O. Hagner, P. Aronsson and M. Söderström</i>	485
iSOIL: exploring the soil as the basis for sustainable crop production and precision farming <i>F.M. van Egmond, A.-K. Nüsch, U. Werban, U. Sauer and P. Dietrich</i>	493
The economic potential of precision farming: an interim report with regard to nitrogen fertilization <i>P. Wagner</i>	501
Section 8 - Geo statistics and path planning	509
Optimal path planning for field operations <i>J.W. Hofstee, L.E.E.M. Spätjens and H. IJken</i>	511
Combined coverage and path planning for field operations <i>D.D. Bochtis and T. Oksanen</i>	521
From sensor values to a map: accuracy of spatial modelling methods in agricultural machinery works <i>J. Kaivosoja</i>	529
Field-scale model of the spatio-temporal vine water status in a viticulture system <i>J.A. Taylor, B. Tisseyre C. Acevedo-Opazo and P. Lagacherie</i>	537
Hydropedology and pedotransfer functions <i>S. Zacharias, D. Altdorff, L. Samaniego-Eguiguren and P. Dietrich</i>	545
Section 9 - Precision agriculture in regional modelling	551
A multi agent simulation approach to assess agronomic income sources in the North China Plain: case study for Quzhou County <i>A. Roth and R. Doluschitz</i>	553
Sensitivity to climate change with respect to agriculture production in Hungary <i>É. Erdélyi</i>	559

Rotation and the temporal stability of landscape defined management zones: a time series analysis <i>E.M. Pena-Yewtukhiw and J.H. Grove</i>	567
Bioclimatic modelling of the future ranges of crop species: an analysis of propagated uncertainty <i>R.J. Corner and M.A. Marinelli</i>	575
Section 10 - Cooperation of robots	583
A framework for motion coordination of small teams of agricultural robots <i>S.G. Vougioukas</i>	585
Model-based loading of agricultural trailers <i>G. Happich, H.-H. Harms and T. Lang</i>	595
Procedures of soil farming allowing to reduce compaction <i>M. Kroulík, T. Loch, Z. Kvíz and V. Prošek</i>	603
Section 11 - Guidance and machine performance	613
Parallel guidance system for tractor-trailer system with active joint <i>J. Backman, T. Oksanen and A. Visala</i>	615
A vision-guided mobile robot for precision agriculture <i>S. Ericson and B. Åstrand</i>	623
An imaging system to characterise the mechanical behaviour of fertilisers in the context of centrifugal spreading <i>S. Villette, E. Piron, R. Martin and C. Gée</i>	631
New high speed image acquisition system and image processing techniques for fertiliser granule trajectory determination <i>B. Hijazi, F. Cointault, J. Dubois, S. Villette, J. Vangeyte, F. Yang and M. Paindavoine</i>	639
Section 12 - Crop modelling	649
Simulating the physiological dynamics of winter wheat after grazing <i>M.T. Harrison, J.R. Evans and A.D. Moore</i>	651
Modelling competition for below-ground resources and light within a winter pea (<i>Pisum sativum</i> L.) – wheat (<i>Triticum aestivum</i> L.) intercrop (Azodyn-InterCrop): towards a decision making oriented-tool <i>P. Malagoli, C. Naudin, G. Goulevant, M. Sester, G. Corre-Hellou, M.-H. Jeuffroy</i>	659
Predicting yields and protein content of lupin/cereal forage crops in organic farming <i>W.M. Azo, G.P.F. Lane, W.P. Davies. and N.D. Cannon</i>	667
Crop modelling based on the principle of maximum plant productivity <i>J. Kadaja, T. Saue and P. Viil</i>	675

Automatic working depth control for seed drill using ISO 11783 compatible tractor <i>P. Suomi, T. Oksanen, A. Ojanne, J. Kalmari, R. Linkolehto and F. Tey</i>	683
A supply/demand, single-organ crop growth model <i>I. Seginer and M. Gent</i>	691
Prediction of within field cotton yield losses caused by the southern root-knot nematode with the cropping system model-CROPGRO-cotton <i>B. Ortiz, G. Hoogenboom, G. Vellidis, K. Boote and C. Perry</i>	699
Use of geographic information systems (GIS) in crop protection warning service <i>T. Zeuner and B. Kleinhenz</i>	707
Plant-specific and canopy density spraying to control fungal diseases in bed-grown crops <i>J.C. van de Zande, V.T.J.M. Achten, H.T.A.M. Schepers, A. van der Lans, J.M.G.P. Michielsen, H. Stallinga and P. van Velde</i>	715
Section 13 - Precision application	723
Robotic control of broad-leaved dock <i>F.K. van Evert, J. Samsom, G. Polder, M. Vijn, H.-J. van Dooren, E.J.J. Lamaker, G.W.A.M. van der Heijden, C. Kempenaar, A.J.A. van der Zalm and L.A.P. Lotz</i>	725
First prototype of an automated rotary hoe for mechanical weeding of the intra-row area in row crops and vegetables <i>Z. Gobor, P. Schulze Lammers and G. Wendl</i>	733
Auto-boom control to avoid spraying pre-defined areas <i>J. Mickelåker and S.A. Svensson</i>	741
Image processing algorithms for a selective vineyard robotic sprayer <i>R. Berenstein, O. Ben Shahr, A. Shapiro, A. Bechar and Y. Edan</i>	749
Assessing the potential of automatic section control <i>T.S. Stombaugh, R.S. Zandonadi and C.R. Dillon</i>	759
Performance of auto-boom control for agricultural sprayers <i>J.P. Molin, E.F. Reynaldo, F.P. Povh and J.V. Salvi</i>	767
The development of a computer vision based and real-time plant tracking system for dot spraying <i>M. Nørremark, H.J. Olsen, N.W. Andreassen and I. Lund</i>	777
SensiSpray: site-specific precise dosing of pesticides by on-line sensing <i>J.C. van de Zande, V.T.J.M. Achten, C. Kempenaar, J.M.G.P. Michielsen, D. van der Schans, J. de Boer, H. Stallinga, P. van Velde and B. Verwijs</i>	785

Section 14 - ICT in precision agriculture	793
Data collection and two-way communication to support decision making by pest scouts <i>A. Hetzroni, M. Meron, I. Fraier, Y. Magrisso and O. Mendelsohn</i>	795
Prototype system of monitoring farm operation with a wearable device and field server <i>T. Fukatsu, K. Sugahara, T. Nanseki and S. Ninomiya</i>	801
Information requirements and data sources for automated irrigation control in tree crops <i>J. Casadesús</i>	809
Geo-enabled hands free registration of tillage activities in arable farming <i>H. Janssen, T. van der Wal, A. Beek, J.A. van Rossum and M. Uytterlinde</i>	817
A multi-level modelling approach for food supply chains using the unified modeling language (UML) <i>R. Lehmann, M. Fritz and G. Schiefer</i>	823
Section 15 - Robots	831
WURking: a small sized autonomous robot for the Farm of the Future <i>E.J. van Henten, C.J. van Asselt, T. Bakker, S.K. Blaauw, M.H.A.M. Govers, J.W. Hofstee, R.M.C. Jansen, A.T. Nieuwenhuizen, S.L. Speetjens, J.D. Stigter, G. van Straten and L.G. Van Willigenburg</i>	833
BoniRob: an autonomous field robot platform for individual plant phenotyping <i>A. Ruckelshausen, P. Biber, M. Dorna, H. Gremmes, R. Klose, A. Linz, R. Rahe, R. Resch, M. Thiel, D. Trautz and U. Weiss</i>	841
Preparing a team to Field Robot Event: educational and technological aspects <i>T. Oksanen, J. Tiusanen and J. Kostamo</i>	849
Safe and reliable: further development of a field robot <i>H.W. Griepentrog, N.A. Andersen, J.C. Andersen, M. Blanke, O. Heinemann, T.E. Madsen, J. Nielsen, S.M. Pedersen, O. Ravn and D. Wulfsohn</i>	857
Simple tunable control for automatic guidance of four-wheel steered vehicles <i>T. Bakker, C.J. van Asselt, J. Bontsema, J. Müller and G. van Straten</i>	867
Development of a small agricultural field inspection vehicle <i>R. Gottschalk, X.P. Burgos-Artizzu and A. Ribeiro</i>	877
Section 16 - Future farming	885
Futurefarm: the European farm of tomorrow <i>B.S. Blackmore</i>	887
Management strategies and practices for precision agriculture operations <i>S. Fountas, S. Pedersen, C. Sorensen, A. Chatzinikos, L. Pesonen, B. Basso, S. Vougioukas, E. Nash, T. Gemtos and S. Blackmore</i>	893

Can compliance to crop production standards be automatically assessed? <i>E. Nash, A. Vatsanidou and S. Fountas</i>	899
Typology of precision farming technologies suitable for EU-farms <i>J. Schwarz, A. Werner and F. Dreger</i>	907
Analysis of external drivers for farm management and their influences on farm management information systems <i>K. Charvat and P. Gnip</i>	915
Potential savings and economic benefits in arable farming from better precision farming and information management <i>S.M. Pedersen, J.E. Ørum, C.G. Sørensen, S. Fountas, L. Pesonen, B.S. Blackmore and B. Basso</i>	919
Farmer's risk in decision making: the case of nitrogen application rates <i>B. Basso, S. Fountas, L. Sartori, G. Cafiero, S.M. Pedersen, C. Sorensen, L. Pesonen, A. Werner and S. Blackmore</i>	927
Technology requirements for a standard information infrastructure to assist compliance with crop production standards <i>E. Nash, R. Nikkilä, L. Pesonen and C.G. Sørensen</i>	935
System analysis of management information systems for the future <i>C.G. Sørensen, S. Fountas, B. Basso, L. Pesonen, S.M. Pedersen and E. Nash</i>	943
Section 17 - European relevance for precision agriculture	951
Future GNSS - Farmers navigate towards trusted farming <i>R.M. Lokers, A. Krause and T. van der Wal</i>	953
New GPS based methods accredited by the EC for area measurement <i>M. Grzebellus</i>	961
URM as tool for Shared Environmental Information System (SEIS) <i>K. Charvat, P. Horak, M. Vlk, S. Kafka and J. Cepicky</i>	967
Common Agricultural Policy and Spatial Data Infrastructures <i>T. van der Wal, W. Devos and S. Kay</i>	973
Keyword Index	983
Author index	988