52. IWK

Internationales Wissenschaftliches Kolloquium
International Scientific Colloquium

PROCCEDINGS | **10 - 13 September 2007**

FACULTY OF COMPUTER SCIENCE AND AUTOMATION

COMPUTER SCIENCE MEETS AUTOMATION

VOLUME I

Session 1 - Systems Engineering and Intelligent Systems

Session 2 - Advances in Control Theory and Control Engineering

Session 3 - Optimisation and Management of Complex Systems and Networked Systems

Session 4 - Intelligent Vehicles and Mobile Systems

Session 5 - Robotics and Motion Systems

TECHNISCHE UNIVERSITÄT
ILMENAU

Bibliografische Information der Deutschen Bibliothek
Die Deutsche Bibliothek verzeichnet diese Publikation in der deutschen Nationalbiografie; detaillierte bibliografische Daten sind im Internet über **http://dnb.ddb.de** abrufbar.

ISBN 978-3-939473-17-6

Impressum

Herausgeber:	Der Rektor der Technischen Universität Ilmenau Univ.-Prof. Dr. rer. nat. habil. Peter Scharff
Redaktion:	Referat Marketing und Studentische Angelegenheiten Kongressorganisation Andrea Schneider Tel.: +49 3677 69-2520 Fax: +49 3677 69-1743 e-mail: kongressorganisation@tu-ilmenau.de
Redaktionsschluss:	Juli 2007
Verlag:	 Technische Universität Ilmenau/Universitätsbibliothek Universitätsverlag Ilmenau Postfach 10 05 65 98684 Ilmenau www.tu-ilmenau.de/universitaetsverlag
Herstellung und Auslieferung:	Verlagshaus Monsenstein und Vannerdat OHG Am Hawerkamp 31 48155 Münster www.mv-verlag.de
Layout Cover:	www.cey-x.de
Bezugsmöglichkeiten:	Universitätsbibliothek der TU Ilmenau Tel.: +49 3677 69-4615 Fax: +49 3677 69-4602

Preface

Dear Participants,

Confronted with the ever-increasing complexity of technical processes and the growing demands on their efficiency, security and flexibility, the scientific world needs to establish new methods of engineering design and new methods of systems operation. The factors likely to affect the design of the smart systems of the future will doubtless include the following:

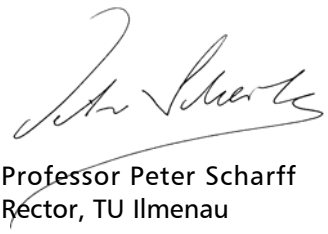
- As computational costs decrease, it will be possible to apply more complex algorithms, even in real time. These algorithms will take into account system nonlinearities or provide online optimisation of the system's performance.
- New fields of application will be addressed. Interest is now being expressed, beyond that in "classical" technical systems and processes, in environmental systems or medical and bioengineering applications.
- The boundaries between software and hardware design are being eroded. New design methods will include co-design of software and hardware and even of sensor and actuator components.
- Automation will not only replace human operators but will assist, support and supervise humans so that their work is safe and even more effective.
- Networked systems or swarms will be crucial, requiring improvement of the communication within them and study of how their behaviour can be made globally consistent.
- The issues of security and safety, not only during the operation of systems but also in the course of their design, will continue to increase in importance.

The title "Computer Science meets Automation", borne by the 52nd International Scientific Colloquium (IWK) at the Technische Universität Ilmenau, Germany, expresses the desire of scientists and engineers to rise to these challenges, cooperating closely on innovative methods in the two disciplines of computer science and automation.

The IWK has a long tradition going back as far as 1953. In the years before 1989, a major function of the colloquium was to bring together scientists from both sides of the Iron Curtain. Naturally, bonds were also deepened between the countries from the East. Today, the objective of the colloquium is still to bring researchers together. They come from the eastern and western member states of the European Union, and, indeed, from all over the world. All who wish to share their ideas on the points where "Computer Science meets Automation" are addressed by this colloquium at the Technische Universität Ilmenau.

All the University's Faculties have joined forces to ensure that nothing is left out. Control engineering, information science, cybernetics, communication technology and systems engineering – for all of these and their applications (ranging from biological systems to heavy engineering), the issues are being covered.

Together with all the organizers I should like to thank you for your contributions to the conference, ensuring, as they do, a most interesting colloquium programme of an interdisciplinary nature.
I am looking forward to an inspiring colloquium. It promises to be a fine platform for you to present your research, to address new concepts and to meet colleagues in Ilmenau.



Professor Peter Scharff
Rector, TU Ilmenau

Professor Christoph Ament
Head of Organisation

Table of Contents

C O N T E N T S

Page

1 Systems Engineering and Intelligent Systems

A. Yu. Nedelina, W. Fengler 3
DIPLAN: Distributed Planner for Decision Support Systems

O. Sokolov, M. Wagenknecht, U. Gocht 9
Multiagent Intelligent Diagnostics of Arising Faults

V. Nissen 15
Management Applications of Fuzzy Conrol

O. G. Rudenko, A. A. Bessonov, P. Otto 21
A Method for Information Coding in CMAC Networks

Ye. Bodyanskiy, P. Otto, I. Pliss, N. Teslenko 27
Nonlinear process identification and modeling using general regression neuro-fuzzy network

Ye. Bodyanskiy, Ye. Gorshkov, V. Kolodyazhniy , P. Otto 35
Evolving Network Based on Double Neo-Fuzzy Neurons

Ch. Wachten, Ch. Ament, C. Müller, H. Reinecke 41
Modeling of a Laser Tracker System with Galvanometer Scanner

K. Lüttkopf, M. Abel, B. Eylert 47
Statistics of the truck activity on German Motorways

K. Meissner, H. Hensel 53
A 3D process information display to visualize complex process conditions in the process industry

F.-F. Steege, C. Martin, H.-M. Groß 59
Recent Advances in the Estimation of Pointing Poses on Monocular Images for Human-Robot Interaction

A. González, H. Fernlund, J. Ekblad 65
After Action Review by Comparison – an Approach to Automatically Evaluating Trainee Performance in Training Exercise

R. Suzuki, N. Fujiki, Y. Taru, N. Kobayashi, E. P. Hofer 71
Internal Model Control for Assistive Devices in Rehabilitation Technology

D. Sommer, M. Golz 77
Feature Reduction for Microsleep Detection

F. Müller, A. Wenzel, J. Wernstedt 83
A new strategy for on-line Monitoring and Competence Assignment to Driver and Vehicle

V. Borikov 89
Linear Parameter-Oriented Model of Microplasma Process in Electrolyte Solutions

A. Avshalumov, G. Filaretov 95
Detection and Analysis of Impulse Point Sequences on Correlated Disturbance Phone

H. Salzwedel 101
Complex Systems Design Automation in the Presence of Bounded and Statistical Uncertainties

G. J. Nalepa, I. Wojnicki 107
Filling the Semantic Gaps in Systems Engineering

R. Knauf 113
Compiling Experience into Knowledge

R. Knauf, S. Tsuruta, Y. Sakurai 119
Toward Knowledge Engineering with Didactic Knowledge

2 Advances in Control Theory and Control Engineering

U. Konigorski, A. López 129
Output Coupling by Dynamic Output Feedback

H. Toossian Shandiz, A. Hajipoor 135
Chaos in the Fractional Order Chua System and its Control

O. Katernoga, V. Popov, A. Potapovich, G. Davydau 141
Methods for Stability Analysis of Nonlinear Control Systems with Time Delay for Application in Automatic Devices

J. Zimmermann, O. Sawodny 145
Modelling and Control of a X-Y-Fine-Positioning Table

A. Winkler, J. Suchý 151
Position Based Force Control of an Industrial Manipulator

E. Arnold, J. Neupert, O. Sawodny, K. Schneider 157
Trajectory Tracking for Boom Cranes Based on Nonlinear Control and Optimal Trajectory Generation

K. Shaposhnikov, V. Astakhov 165
The method of ortogonal projections in problems of the stationary magnetic field computation

J. Naumenko 167
The computing of sinusoidal magnetic fields in presence of the surface with bounded conductivity

K. Bayramkulov, V. Astakhov 169
The method of the boundary equations in problems of computing static and stationary fields on the topological graph

T. Kochubey, V. Astakhov 171
The computation of magnetic field in the presence of ideal conductors using the Integral-differential equation of the first kind

M. Schneider, U. Lehmann, J. Krone, P. Langbein, Ch. Ament, P. Otto, U. Stark, J. Schrickel 173
Artificial neural network for product-accompanied analysis and control

I. Jawish 179
The Improvement of Traveling Responses of a Subway Train using Fuzzy Logic Techniques

Y. Gu, H. Su, J. Chu 185
An Approach for Transforming Nonlinear System Modeled by the Feedforward Neural Networks to Discrete Uncertain Linear System

3 Optimisation and Management of Complex Systems and Networked Systems

R. Franke, J. Doppelhammer 193
Advanced model based control in the Industrial IT System 800xA

H. Gerbracht, P. Li, W. Hong 199
An efficient optimization approach to optimal control of large-scale processes

T. N. Pham, B. Wutke 205
Modifying the Bellman's dynamic programming to the solution of the discrete multi-criteria optimization problem under fuzziness in long-term planning

S. Ritter, P. Bretschneider 211
Optimale Planung und Betriebsführung der Energieversorgung im liberalisierten Energiemarkt

P. Bretschneider, D. Westermann 217
Intelligente Energiesysteme: Chancen und Potentiale von IuK-Technologien

Z. Lu, Y. Zhong, Yu. Wu, J. Wu 223
WSReMS: A Novel WSDM-based System Resource Management Scheme

M. Heit, E. Jennenchen, V. Kruglyak, D. Westermann 229
Simulation des Strommarktes unter Verwendung von Petrinetzen

O. Sauer, M. Ebel 237
Engineering of production monitoring & control systems

C. Behn, K. Zimmermann 245
Biologically inspired Locomotion Systems and Adaptive Control

J. W. Vervoorst, T. Kopfstedt 251
Mission Planning for UAV Swarms

M. Kaufmann, G. Bretthauer 257
Development and composition of control logic networks for
distributed mechatronic systems in a heterogeneous architecture

T. Kopfstedt, J. W. Vervoorst 263
Formation Control for Groups of Mobile Robots Using a Hierarchical
Controller Structure

M. Abel, Th. Lohfelder 269
Simulation of the Communication Behaviour of the German Toll System

P. Hilgers, Ch. Ament 275
Control in Digital Sensor-Actuator-Networks

C. Saul, A. Mitschele-Thiel, A. Diab, M. Abd rabou Kalil 281
A Survey of MAC Protocols in Wireless Sensor Networks

T. Rossbach, M. Götze, A. Schreiber, M. Eifart, W. Kattanek 287
Wireless Sensor Networks at their Limits – Design Considerations
and Prototype Experiments

Y. Zhong, J. Ma 293
Ring Domain-Based Key Management in Wireless Sensor Network

V. Nissen 299
Automatic Forecast Model Selection in SAP Business Information
Warehouse under Noise Conditions

M. Kühn, F. Richter, H. Salzwedel 305
Process simulation for significant efficiency gains in clinical departments –
practical example of a cancer clinic

D. Westermann, M. Kratz, St. Kümmerling, P. Meyer 311
Architektur eines Simulators für Energie-, Informations- und Kommunikations-technologien

P. Moreno, D. Westermann, P. Müller, F. Büchner 317
Einsatzoptimierung von dezentralen netzgekoppelten Stromerzeugungs-anlagen (DEA) in Verteilnetzen durch Erhöhung des Automatisierungsgrades

M. Heit, S. Rozhenko, M. Kryvenka, D. Westermann 331
Mathematische Bewertung von Engpass-Situationen in Transportnetzen elektrischer Energie mittels lastflussbasierter Auktion

M. Lemmel, M. Schnatmeyer 339
RFID-Technology in Warehouse Logistics

V. Krugljak, M. Heit, D. Westermann 345
Approaches for modelling power market: A Comparison.

St. Kümmerling, N. Döring, A. Friedemann, M. Kratz, D. Westermann 351
Demand-Side-Management in Privathaushalten – Der eBox-Ansatz

4 Intelligent Vehicles and Mobile Systems

A. P. Aguiar, R. Ghabchelloo, A. Pascoal, C. Silvestre , F. Vanni 359
Coordinated Path following of Multiple Marine Vehicles: Theoretical Issues and Practical Constraints

R. Engel, J. Kalwa 365
Robust Relative Positioning of Multiple Underwater Vehicles

M. Jacobi, T. Pfützenreuter, T. Glotzbach, M. Schneider 371
A 3D Simulation and Visualisation Environment for Unmanned Vehicles in Underwater Scenarios

M. Schneider, M. Eichhorn, T. Glotzbach, P. Otto 377
A High-Level Simulator for heterogeneous marine vehicle teams under real constraints

A. Zangrilli, A. Picini 383
Unmanned Marine Vehicles working in cooperation: market trends and technological requirements

T. Glotzbach, P. Otto, M. Schneider, M. Marinov 389
A Concept for Team-Orientated Mission Planning and Formal Language Verification for Heterogeneous Unmanned Vehicles

M. A. Arredondo, A. Cormack 395
SeeTrack: Situation Awareness Tool for Heterogeneous Vehicles

J. C. Ferreira, P. B. Maia, A. Lucia, A. I. Zapaniotis 401
Virtual Prototyping of an Innovative Urban Vehicle

A. Wenzel, A. Gehr, T. Glotzbach, F. Müller 407
Superfour-in: An all-terrain wheelchair with monitoring possibilities to enhance the life quality of people with walking disability

Th. Krause, P. Protzel 413
Verteiltes, dynamisches Antriebssystem zur Steuerung eines Luftschiffes

T. Behrmann, M. Lemmel 419
Vehicle with pure electric hybrid energy storage system

Ch. Schröter, M. Höchemer, H.-M. Groß 425
A Particle Filter for the Dynamic Window Approach to Mobile Robot Control

M. Schenderlein, K. Debes, A. Koenig, H.-M. Groß 431
Appearance-based Visual Localisation in Outdoor Environments with an Omnidirectional Camera

G. Al Zeer, A. Nabout, B. Tibken 437
Hindernisvermeidung für Mobile Roboter mittels Ausweichecken

5 Robotics and Motion Systems

Ch. Schröter, H.-M. Groß 445
Efficient Gridmaps for SLAM with Rao-Blackwellized Particle Filters

St. Müller, A. Scheidig, A. Ober, H.-M. Groß 451
Making Mobile Robots Smarter by Probabilistic User Modeling and Tracking

A. Swerdlow, T. Machmer, K. Kroschel, A. Laubenheimer, S. Richter 457
Opto-acoustical Scene Analysis for a Humanoid Robot

A. Ahranovich, S. Karpovich, K. Zimmermann 463
Multicoordinate Positioning System Design and Simulation

A. Balkovoy, V. Cacenkin, G. Slivinskaia 469
Statical and dynamical accuracy of direct drive servo systems

Y. Litvinov, S. Karpovich, A. Ahranovich 477
The 6-DOF Spatial Parallel Mechanism Control System Computer Simulation

V. Lysenko, W. Mintchenya, K. Zimmermann 483
Minimization of the number of actuators in legged robots using biological objects

J. Kroneis, T. Gastauer, S. Liu, B. Sauer 489
Flexible modeling and vibration analysis of a parallel robot with numerical and analytical methods for the purpose of active vibration damping

A. Amthor, T. Hausotte, G. Jäger, P. Li 495
Friction Modeling on Nanometerscale and Experimental Verification

Paper submitted after copy deadline

2 Advances in Control Theory and Control Engineering

V. Piwek, B. Kuhfuss, S. Allers
Feed drivers – Synchronized Motion is leading to a process optimization 503

R. Güttler, A. Schneider, Ch. Ament, J. Schmitz
Using a reinforcement learning approach in a discrete event manufacturing system

nur online verfügbar/only on-line ones available

M. Lemmel / M. Schnatmeyer

RFID-Technology in Warehouse Logistics

Wireless technology becomes more important in logistics processes. Beside the usage of GPS or GSM technology for tracking and tracing of goods in the external logistics also internal logistics processes have a high demand on wireless technologies, which supports the quality, environmental and safety management. This paper resumes results from research projects, which have examined wireless technologies for positioning and identification of goods in warehouses.

State-of-the-Art in Wireless Technologies

Wireless technologies open the possibility for the seamless tracking and tracing of logistics process. For external logistics processes GPS and GSM technologies are in use for the position finding of logistics items. For internal logistics processes in a covered warehouse GPS is not available and GSM to imprecise for location goods on pallet level.

Alternative technologies for in-door processes are for example optical (Infrared), DECT, WLAN or RFID. WLAN utilizes spread-spectrum technology based on radio waves to enable communication between devices in a limited area, also known as the basic service set. This gives users the mobility to move around within a broad coverage area and still be connected to the network[1]. Further the WLAN infrastructure enables determining the position of a user or item in this network.

Radio-frequency identification

Radio-frequency identification (RFID) is an automatic identification method such as barcode, relying on storing and remotely retrieving data using devices called RFID tags or transponders. An RFID tag is a device that can be attached to or incorporated into a product, animal, or person for the purpose of identification using radio waves. Chip-based RFID tags contain silicon chips and antennas. It operates at standardised frequencies between 134 kHz (LF), 13,56 MHz (HF) up to 868 / 915 MHz (UHF) [1].

[1] http://en.wikipedia.org/wiki/Wireless_LAN (3/22/2007)

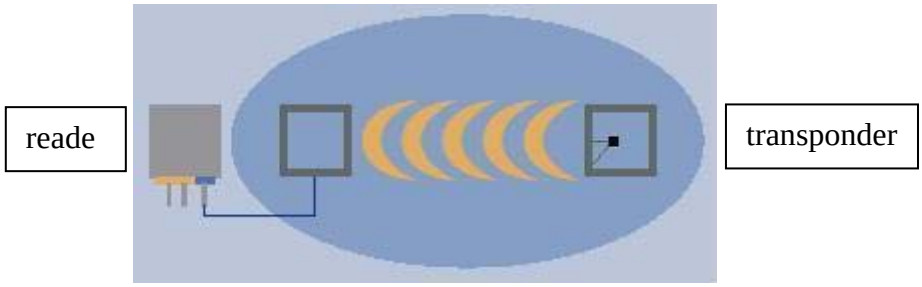


Figure 1: Principle of RFID

Passive tags require no internal power source[2]. The antenna uses the radio field of an RFID reader for supplying the chip with energy. After the chip starts to operate, the transponder can exchange data with the reader (see Figure 1). Besides reading data, the reader can also write data on the transponder.

A typical application for passive RFID systems is the gate solution (see Figure 2).

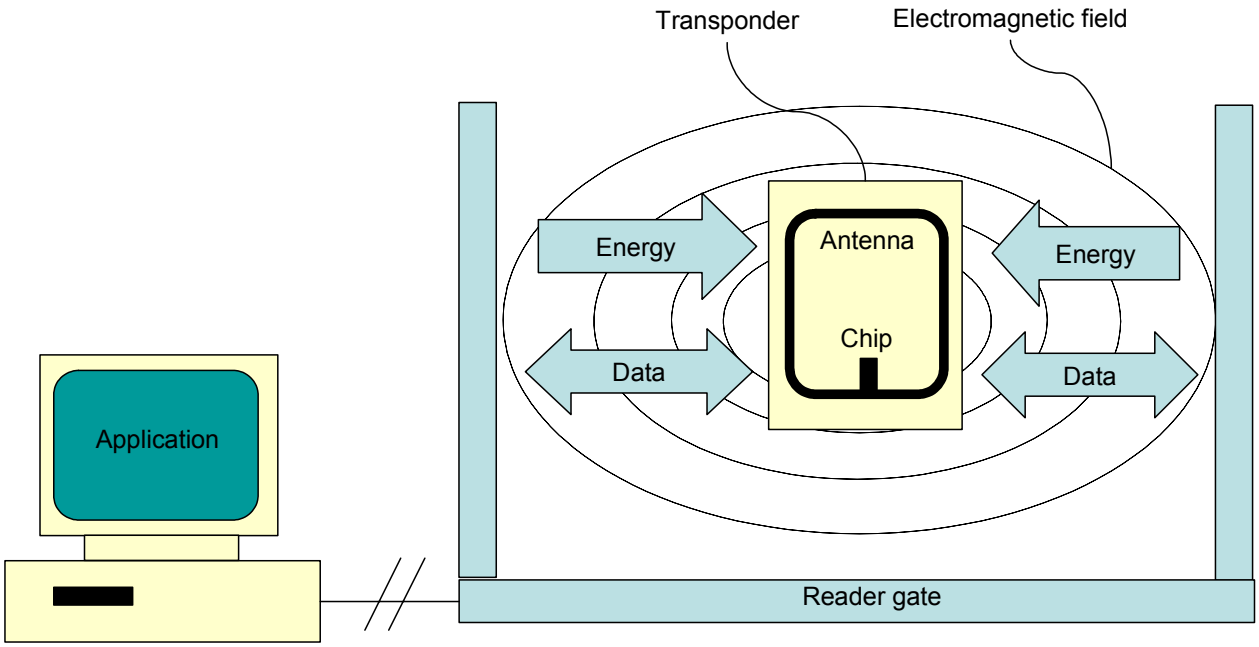


Figure 2: Principle of reader gate

In the centre of the gate it is possible to identify many tagged goods simultaneously. This type of configuration is often in use for retail and wholesale applications. Figure 3 shows a passive transponder which operates at 134 kHz.

[2] http://en.wikipedia.org/wiki/Rfid (3/22/2007)

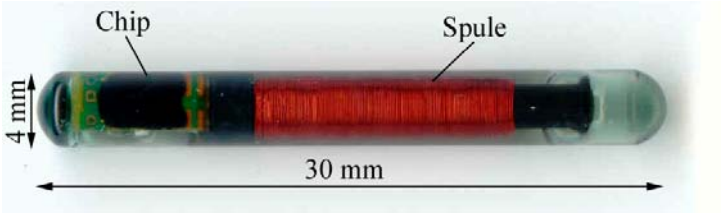


Figure 3: LF-Transponder (134 kHz)

Active transponders have onboard power supply. They have the opportunity to transmit data without being electromagnetically activated. This is reasonable in RFID-S (-sensor) for sensorial supervision of temperature or humidity etc.

For certain applications RFID has significant advantages against ordinary barcode. Some examples are:

- complicated optical detection, e. g. in refrigerated warehouse
- detection of piles, e. g. pallet full packed with different goods (see Figure 2)
- secondary data to be stored on tag, e. g. classification of hazardous goods
- sensorial supervision, e. g. temperature, humidity etc.
- high rate of circulation, e. g. tag integrated into deposit pallet

As the well known systems for positioning like GPS or GSM are just suitable for outdoor purposes, other systems have to be considered for in-house use. Nowadays many factories and warehouses facilities are already equipped with WLAN for data transmission. This existing infrastructure can also be used for position purposes. These in-house positioning systems, such as ekahau[3] base on triangulation between a couple of access points and enables positioning on a cheap way. WLAN based positioning systems have also been evaluated within several research projects for in-house applications with the following disadvantages as results:

- The accuracy of ca. 3 m is insufficient for positioning goods in sizes of a euro-pellet or less.
- Due to the complex algorithms for processing the position the system is not suitable for real-time applications.
- The performance of the system is varying with the signal quality of the WLAN access, which can be alloyed by certain goods such as metal und fluids.

Therefore a new method for in-house positioning based on RFID has been implemented within a couple of actual research activities.

[3] http://www.ekahau.com

RFID Positioning

Figure 4 describes a RFID positioning system, which was developed and used within the research project OPAK (Optimized PAcKing logistics in the life cycle economy) funded by the German ministry of education and research (BMBF). The project was focussing on the optimisation of the redistribution of plastic materials for recycling processes. Main goal was to improve logistic processes and optimise available technological infrastructures through RFID technology.[4]

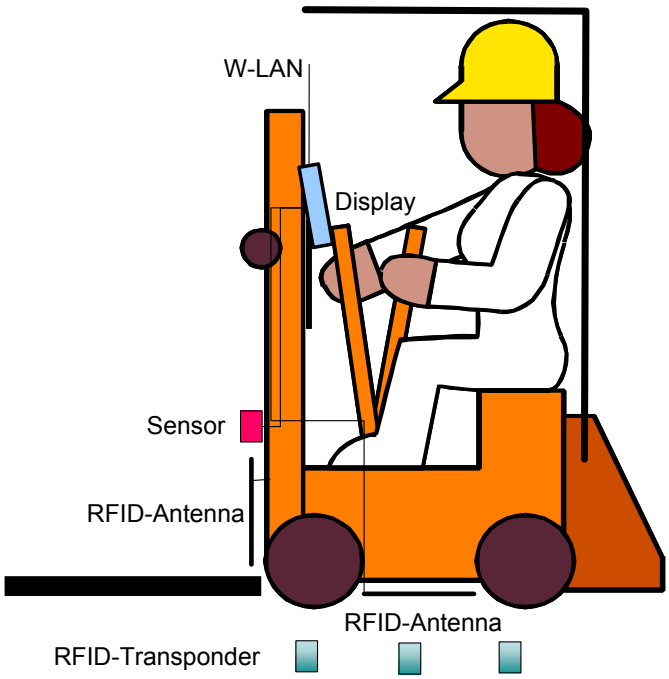


Figure 4: RFID positioning system [2]

For identification one RFID antenna is placed above the fork. This is responsible for reading information from the handled good or its pallet. A second RFID antenna is attached beneath the fork lift. This antenna reads the geographic data coming from the RFID transponder embedded into the warehouse ground.

Two additional ultrasonic sensors are installed at the front of the forklift: One sensor detects picked products on the fork. A second sensor measures the distance between fork and ground for calculating the storage level. This functionality is necessary for block and rack storage applications.

Combined with WLAN access, data collected from the cargo and the warehouse ground can be transmitted to a central WMS (Warehouse Management System) which traces the material movements and placement in the warehouse (or production plant) and provides the driver of the forklift with new transport orders after finishing the actual job.

[4] http://www.biba.uni-bremen.de/projects/opak/Opak_homepage.htm

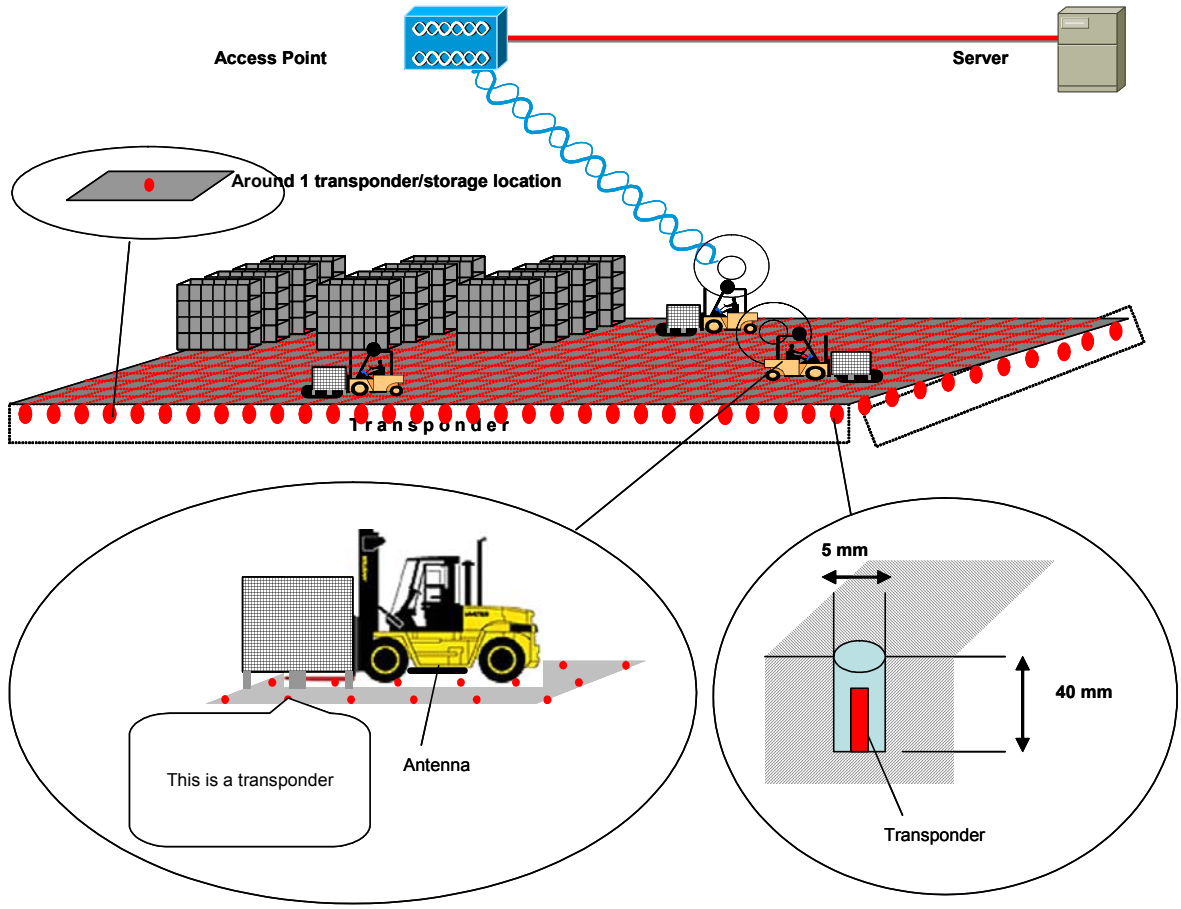


Figure 5: OPAK demonstrator overview

In addition this system can also be used to provide the fork lift driver with additional information, e.g. about dangerous materials, which have to be handled with care. As an example Figure 6 shows the user interface of the touch screen display. If the system identifies dangerous goods the traffic light will change from green to yellow (semi dangerous goods) or red (high dangerous goods).

This semi automated system is optimised for SMEs [3]. High investments in full automated systems seem to be inefficient at this type of industry because the logistic process can not be standardised.

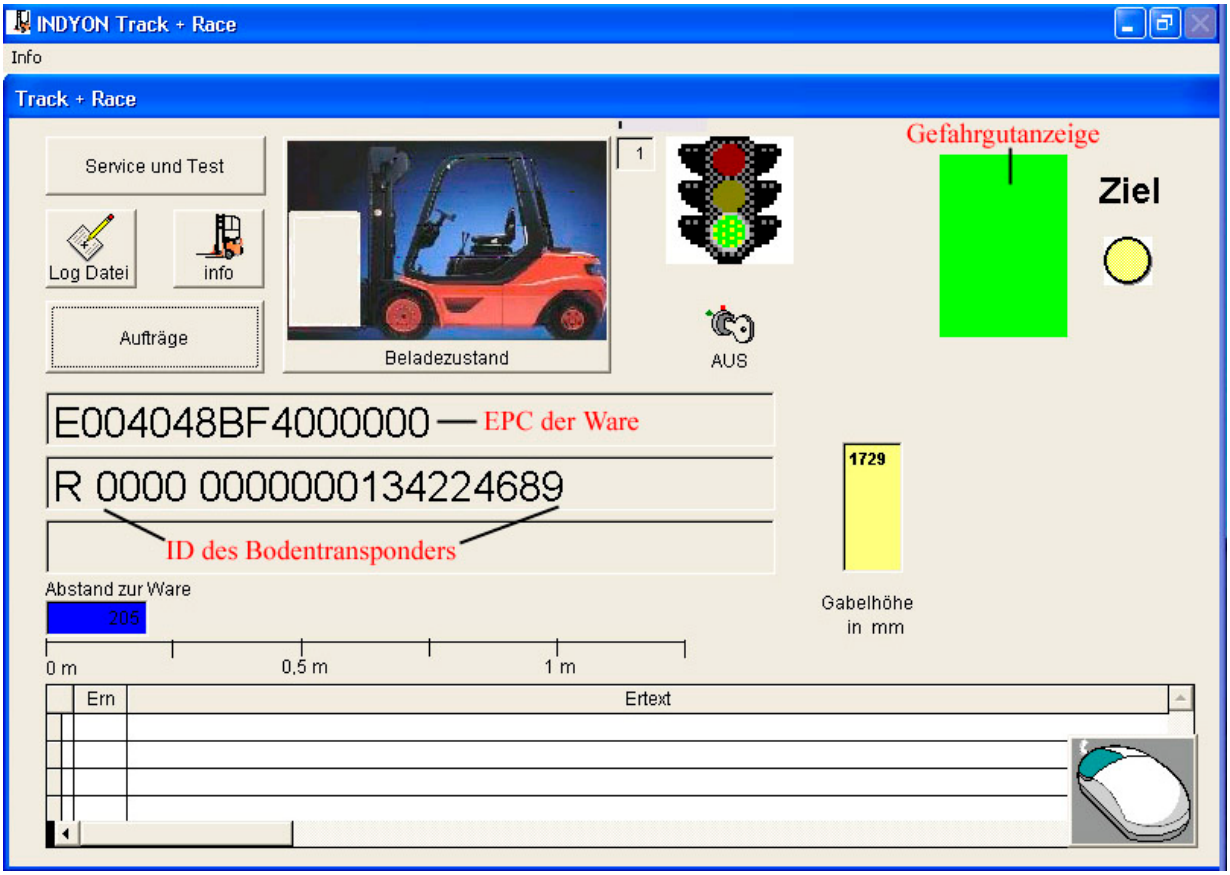


Figure 6: Display of the fork lift terminal [4]

Conclusion

The usage of RFID technology instead of barcode systems is depending on the specific application scenario. For in-house positioning the described RFID system is an attractive opportunity with sufficient accuracy at real time.

For identification purposes it is nowadays difficult to apply existing RFID systems to a whole process chain regarding to missing standards.

References:

[1] Lemmel, M.; Plettner, A.; Schnatmeyer, M.: Optimierte Ein- und Auslagerung von Packstücken. Technische Umsetzung eines exemplarischen Realisierungskonzepts für Recyclingbetriebe. ZWF Zeitschrift für wirtschaftlichen Fabrikbetrieb, Band 101 (2006) Heft 3, Seite 109-113. München 2006.
[2] Hans, C., Schnatmeyer, M., Schumacher, J., Thoben, K.-D.: Using Transponder Technology to Support the End-of-Life Phase in Product Life Cycle Management. Inter-national IMS Forum 2004 – Global Challenges in Manufacturing; Proceedings, Cernobbio, Italy, 17 – 19 May 2004; S. 1448 – 1455. (ISBN 88 901168 9 7)
[3] Schnatmeyer, M.: MS Engineering & Consulting, Efficient Stock Management. http://www.e.inos.de/3.html.
[4] Goch, G.; Thoben, K.-D.; Plettner, A.; Lemmel, M.; Schnatmeyer, M.; Christ, J.; Zhao, X.: Abschlussbericht zum Forschungsvorhaben Optimierte Verpackungslogistik in der Kreislaufwirtschaft (OPAK). Forschungsbericht. Hannover 2006 (TIB-Hannover, http://edok01.tib.uni-hannover.de/edoks/e01fb06/515071951.pdf).

Authors:

Dr. Marc C. Lemmel
BIBA
Hochschulring 20
28359 Bremen
Phone: +49 421 218 5627
Fax: +49 421 218 5625
E-mail: lem@biba.uni-bremen.de

Martin Schnatmeyer
MS Engineering & Consulting
Teerhof 34
28199 Bremen
Phone: + 49 421 59 751 80
Fax: + 49 421 59 751 81
E-mail: schnatmeyer@inos.de