

Dear Readers,

While the cognitive robot as a butler for everyone is still way off in the future, the rapid maturation of cognitive interaction technology offers many stepping stones for applications that may be much closer around the corner.

Two examples reported in this issue present CITEC projects sharing the idea of offering "interaction enhancements" to the user. The first one, developed in a cooperation with medical partners, has developed a dedicated VR environment to shape every-day experiences in a way that can contribute to the diagnosis and rehabilitation of brain disorders. The second project pioneers examples of enriching our use of daily objects, such as chairs or keyboards, with unobtrusive acoustic background information to provide us with useful feedback.

The potential for interaction enhancements that are useful and that enrich our user experience is large and appears as a natural path towards an unobtrusive technology that can evolve in an incremental way towards a realization of a "deep assistance" for people long before the robot butler is knocking at our doors.

Sincerely yours,

Helge Ritter, CITEC Coordinator

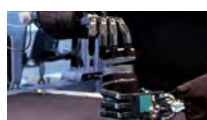
CITEC NEWS

- ▶ **5th place in RoboCup Worldcup** CITEC's Team ToBi made it into the finals at this year's RoboCup World Cup in Istanbul, July 5th to 11th, finishing in 5th place in the @HOME League. After 2009 and 2010 the third world cup participation brought the best result so far for the mainly student run team ToBi. The RoboCup world cup is the most important competition for robots and their programmers - the @HOME League challenges service robots with tasks drawn from basic household activities.
- ▶ **"Future Now" website** The Bielefeld - Osaka cooperation was portrayed in a multimedia feature for the new „Future Now" website offering insights into robotic labs at CITEC as well as Osaka University. The site produced by Deutsche Welle and supported by the German Federal Ministry of Education and Research presents german scientific cooperation worldwide with the focus on innovations with the power of "shaping tomorrow".
- ▶ <http://futurenow.dw-world.de>
- ▶ **Japan Week at Bielefeld University** On the occasion of the anniversary 150 years of friendship between Germany and Japan a Japan Week was held at Bielefeld University from June 6th through June 10th 2011. CITEC contributed to the diverse programme of cultural as well as informational events with a day's programme of talks and poster-sessions on robotics research.
- ▶ **Upcoming Workshops at CITEC**
 - 2nd Bielefeld-Osaka Workshop, Embodied & Situated Language Processing 2011, Aug 25 to 27
 - Workshop on Insect Homing: Mechanisms and Models, August 31 to September 2
 - GESPIN 2011: Gesture and Speech in Interaction, September 5 to 7
 - Workshop on Neurobiology of Embodied Language, October 6 - 7
 - Embodied Simulations for Cognitive Interaction, November 21 - 22

<http://www.cit-ec.de/news>

Four films to display CITEC research

Motion Intelligence, Attentive Systems, Situated Communication and Memory and Learning are the names of the four research areas at CITEC as well as for four newly produced short films giving an illustrative account of these lines of research. The films offer insights into many laboratories at CITEC and shed light on how interdisciplinary collaboration is yielding results in understanding and technologically modelling cognitive abilities. The films can be watched at the CITEC website (www.cit-ec.de/media) or on CITEC's YouTube channel (www.youtube.com/citecbielefeld).



Motion Intelligence



Attentive Systems



Situated Communication



Memory and Learning

Rehabilitation of disturbed brain functions using Virtual Reality – the CITmed Project

Diagnosis of “real-life” competencies such as complex sequential actions cannot reliably be accomplished using laboratory paper-and-pencil or computer-based neuropsychological tests. Conversely, the use of classic neuropsychological training methods for the rehabilitation of disturbed brain functions resulting from neurological or psychiatric diseases (e.g. stroke, depression) includes the problem of transferring cognitive improvements achieved in a laboratory context into the patients’ everyday life. In real-life, performance of an action needs to consider complex space- and time-coded experiences to be successful in a given situational context. Here, interactive Virtual Reality (VR) technology could establish virtual scenarios close to everyday life, thus offering the patients a training environment that may bridge the discrepancy between laboratory assessment and competencies needed in everyday life.

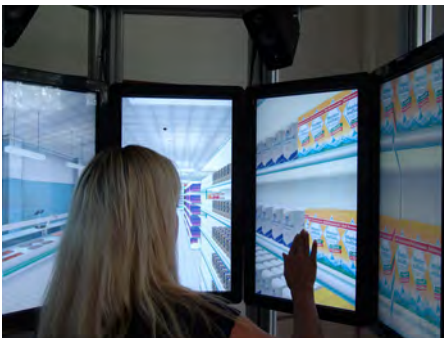


Fig. 1: OctaVis 360°-VR apparatus

In the CITmed project, CITEC researchers have developed a novel 360°-VR apparatus – the OctaVis – that allows for the experimentally controlled assessment and rehabilitation of attentional, learning and memory processes in a VR supermarket. Using this VR technology, the researchers are able to measure and improve both higher cognitive and complex sequential motor actions involved in different shopping tasks. To achieve maximum technical, psychological, and clinical expertise in this highly interdisciplinary project, the AG Computer Graphics of the Faculty of Technology and the AG Physiological Psychology of the Department of Psychology work closely together with the Clinics of Neurology, Psychiatry and Epilepsy in Bethel and the Clinic for Rehabilitation in Bad Driburg. The OctaVis system provides a full 360° panorama visualization of the virtual world by arranging eight touch-screen monitors in a circle around the patient, who is sitting on a swivel chair in the centre of the OctaVis (Figure 1). By rotating the chair and using a joystick in the armrest, patients can navigate

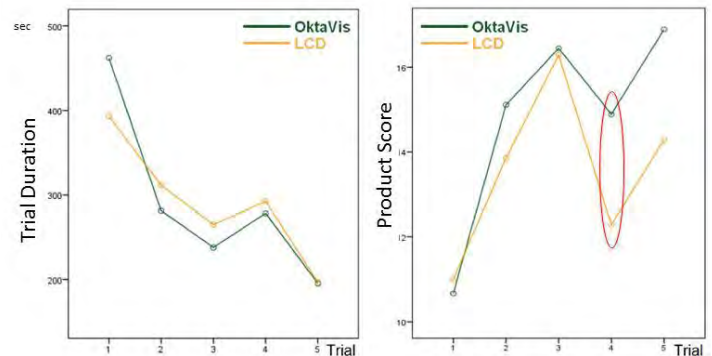


Fig. 2: (A) Product score of each trial for the group OctaVis (green) and LCD (orange).

(B) Duration of each trial for group OctaVis (green) and LCD (orange). Decrease of performance in trial 4 (interference list)

through the virtual scene. The touch-screen monitors allow an interaction with VR objects. A loudspeaker system furthermore provides real-time 3D acoustic stimulation. Eye- and head-tracking systems record ocular movements and 3D gaze direction. The OctaVis is well suited for treatment of patients since the visualization of the virtual environment is highly immersive and the interaction with the VR is easy and intuitive.

The efficacy of this novel system for the training of cognitive functions in healthy human subjects has recently been tested and results have been compared with those of cognitive training using a 17" LCD screen (Grewe et al., 2011). Participants bought the same 20 goods (shopping list A) on three consecutive days and another 20 goods (shopping list B; interference list) on day 4. On day 5, they again bought the list A products without new learning of list A items. The data show a significant increase of the learning during the 5-day training of the shopping task for both the OctaVis and the LCD screen. However, the OctaVis learning is more resistant against effects of interference (Figure 3).

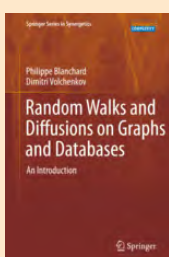
[1] Grewe, P., Kohsik, A., Flentge, D., Degenhardt, I., Dyck, E., Botsch, M., Piefke, M. (2011). Evaluation of a 360°-Virtual Reality Supermarket for Neuropsychological Assessment and Training of Real-Life Memory Functions. 26. Jahrestagung der Gesellschaft für Neuropsychologie (GNP), Aachen, 22.09.-24.09.2011.

CITmed – Cognitive Interaction Technology for Medicine is supported by the NRW Ziel 2 program EFRE. Coordinators: Prof. Dr. Mario Botsch, PD Dr. Martina Piefke

► Books

Random Walks and Diffusions on Graphs and Databases

Philippe Blanchard, Dimitri Volchenkov



Most networks and databases that humans have to deal with contain large, albeit finite number of units. Their structure, for maintaining functional consistency of the components, is essentially not random and calls for a precise quantitative description of relations between nodes (or data units) and all network components. This book is an introduction, for both graduate students and newcomers to the field, to the theory of graphs and random walks on such graphs. The methods based on random walks and diffusions for exploring the structure of finite connected graphs and databases are reviewed (Markov chain analysis). This provides the necessary basis for consistently discussing a number of applications such diverse as electric resistance networks, estimation of land prices, urban planning, linguistic databases, music, and gene expression regulatory networks.

Publisher: Springer, ISBN 978-3-642-19591-4

CITEC Summer School 2011

The 2nd CITEC Summer School will take place from 3rd – 8th of October, 2011 at Bielefeld University. Entitled “Mechanisms of Attention – From Experimental Studies to Technical Systems”, the weeklong Summer School will address the issue of attention in the interdisciplinary context of CITEC.

Comprising lectures by invited speakers, as well as practical courses by CITEC colleagues, organized in their labs, the annual Summer School is a great occasion to connect with members of CITEC’s Virtual Faculty. With 15 to 20 external participants from all over the world matched by the same number of internal PHD-students the CITEC Summer School offers opportunities for exchange among participants as well as with experienced researchers.

Participants will be trained to handle a wide range of perspectives, such as e.g. a technological perspective on system integration, a biological and biomechanical one, as well as mechanisms of attention and perception, a set of psychological and linguistic approaches, and application of models in robotic systems.

The guest speakers in 2011 are:

- Ehud Ahissar (Weizmann Institute of Science in Rehovot, Israel)
- Dana Ballard (University of Texas at Austin, USA)
- Gustavo Deco (University Pompeu Fabra, Spain)
- Mary Hayhoe (University of Texas at Austin, USA)
- Gordon Logan (Vanderbilt University, USA)
- John Tsotsos (York University, Canada)
- Mark Williams (John Moores University Liverpool, GB)

Deadline for applications is August 14th.

Online application for participation :

► <http://www.cit-ec.de/summerschool>

Research Group: Language and Cognition



The Language and Cognition group, founded in January 2009, comprises Pia Knoeferle (PI) three postdoctoral members (Dr. Michele Burigo, Dr. Maria Nella Carminati, and Dr. Helene Kreysa), three graduate students (Raymond Becker, Ernesto Guerra, and Lu Zhang), a visiting student (Lily Kornbluth), and several Master’s students and student assistants (Dato Abashidze, Bridgette DeCot, Katja Glados, Eva Mende, Eva Nunnemann, and Linda Krull).

Dr. Knoeferle graduated in English Philology, Romance Studies, Philosophy (M.A.), and in English, French, and Sports („1. Staatsexamen“, a teaching degree) from the University of Regensburg, Germany. She received a PhD in Computational Linguistics from Saarland University Germany in 2005 with „summa cum laude“ and was awarded the Eduard–Martin Prize for outstanding dissertations at Saarland University. After a postdoctoral position at Saarland University, she was awarded a two-year postdoctoral fellowship (German Research Council) which she held at the University of California, San Diego. During that time she founded a workshop series „Embodied and situated language processing“ (www.embodiedlanguage.org) which has taken place in Saarbrücken (2007), Rotterdam (2009), San Diego (2010), and most recently in Bielefeld at the Center for Interdisciplinary Research. In January 2009 she moved back to Germany as a newly appointed Assistant Professor (Juniorprofessorin) at CITEC and the Department of Linguistics at Bielefeld University. Dr. Knoeferle is an adhoc reviewer for key journals in her field as well as for diverse funding agencies.

Research Interest

The group investigates real-time language processing. This includes studies on the

effects of non-verbal context during incremental language understanding, how spoken language comprehension interacts with attention to objects and events; how parallelism affects human parsing; the contribution of verification processes to language comprehension; and collaborations on computational modeling of visually situated language comprehension. The research in the group aims to contribute towards further developing models of situated language comprehension, and informing cognitive interaction technology. In her work, Dr. Knoeferle relies upon behavioral (e.g., eye tracking), neuroscientific (event-related brain potentials), and computational approaches. Research in the group has been published in international journals and has led to the publication of a special issue with Brain and Language.

Ongoing projects in the group examine:

- effects of speaker gaze and emotional mimics on spoken language comprehension
- effects of spatial cues during human language comprehension and visual perception
- effects of depicted and real-world actions on language comprehension
- how abstract language comprehension is grounded in our visual environment
- visual context effects in child versus adult language comprehension
- effects of temporal cues on language understanding
- effects of a virtual speaker’s gaze, mimics, and gestures on human language comprehension and behavior

Collaborations

- Prof. Pinie Zwitserlood (University of Münster, Germany)
- Prof. Marta Kutas and Thomas Urbach (Dept. of Cognitive Science, UC San Diego, USA)
- Prof. Seana Coulson (Dept. of Cognitive Science, UC San Diego, USA)
- Prof. Martin Pickering (Dept. of Psychology, Edinburgh University)
- Dr. Roger van Gompel (Dept. of Psychology, University of Dundee, UK)
- Prof. Rolf Zwaan (Institute of Psychology, Erasmus University Rotterdam, Netherlands)
- Prof. Kenny Coventry (Northumbria University, UK)
- Dr. Greta Sacchi (University of Milan–Bicocca, Italy)

Sonic Interaction Design

Sound is an important part of our everyday experience and sounds accompany us almost 24 hours the day. Besides speech and music there are many background sounds and impact sounds that are useful for coordinating our daily routines: sound draws our attention, informs us on each footstep about material characteristics of the floor, sounds create a sense of presence and also an emotional quality. The importance of sound for products has been recognized and engineers design the crunchiness of cereals and car type specific door slamming sounds that make it feel solid or expensive. Yet when it comes to human-computer interaction, and particularly to data mining, sound is missing or highly neglected.

For the past 4 years, the EU COST Action ICo601 SID (Sonic Interaction Design) has shown ways how sound can enhance artifacts and products, and create new experiences, from arts to technology. Dr. Thomas Hermann (head of the Ambient Intelligence Group at CITEC) herein served as vice-chair of the COST Action and as leader of the working group on Sonification. Sonification, the systematic auditory representation of data has evolved as a research area related to visualization but addressing our sense of hearing. In his team at CITEC, many methods have been developed



Fig. 1: SonicChair

to make more productive use of such information conveying functional sounds, such as an auditory adjustment aid for a drilling machine, interactive feedback for sportsmen to conduct dance or sports movements, interaction tools that allow visually impaired pupils to hear mathematical functions, etc.

Two recent works of the Ambient Intelligence group demonstrate how sound can add and refine very subtle information streams to everyday objects, and have been selected for a curated exhibition on Sonic Interaction Design [1], which is currently open to public in the Oslo museum of Science and Technology until the end of August. The first is the **SonicChair** (by T. Hermann and R. Kõiva) [2], an office chair equipped with force-sensitive sensors to measure the user's behavior. Sound is only produced when the user is seated but remains physically inactive for an extended time, e.g. 5–10 minutes. To induce a more active and healthy pattern, faint sounds increase gradually in sound level until they become noticeable – yet not disturbing. At some moment the user may – consciously or subconsciously – be reminded to stretch the back or to move on the chair, which in turn resets the 'laziness counters' so that the sound disappears. If only a small fraction of the back problems of the millions of office workers could be reduced by such an attention-drawing technology, this could be enormously beneficial, not only for the users but also for the health systems.

Auditory Augmentation at your Fingertips (by R. Tünnermann, T. Bovermann and T. Hermann) [3] demonstrates how existing interaction sounds in an office can be refined to communicate some data of interest. A contact microphone picks up the structure-borne sound while typing on a keyboard. These sounds are filtered interactively at low latency so that the reproduced sound merges with the real object sounds into a single perceptual unit. The key idea is to drive the filter parameters (e.g. center frequencies and bandwidth) by external data of interest. For instance, the actual sales

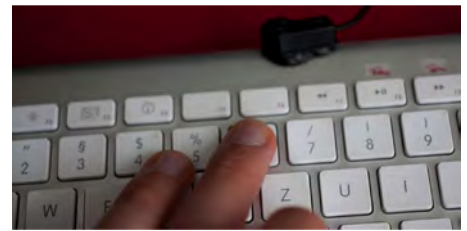


Fig. 2: Auditory Augmentation at your Fingertips

rates of market shares or the number of unreplied emails, or the weather measured at a specific location could be mapped to influence the sound. Since this implicit auditory display operates on a subtle and unobtrusive communication level, it interferes with the user much less than a display that requires active information polling. Both research works show how sonification can make novel contributions to Ambient Intelligence.

[1] SID exhibition website at <http://sid.bek.no>

[2] Hermann, T. & Kõiva, R. (2008). *tacTiles for Ambient Intelligence and Interactive Sonification*. In: *Haptic Audio Interaction Design (HAID 2008)*, Jyväskylä, Finland Pirhonen, A. & Brewster, S.A. eds. Springer. 91–101.

[3] Bovermann, T., Tünnermann, R. & Hermann, T. (2010). *Auditory Augmentation*. *International Journal on Ambient Computing and Intelligence (IJACI)*, 2(2) 27–41.

Dr. Thomas Hermann is head of the Ambient Intelligence Group at CITEC; **Dipl. Inf. Rene Tünnermann** is a PhD student in the Ambient Intelligence Group at CITEC; **Dipl. Inf. Risto Kõiva** conducts research in cognitive robotics within the CITEC Neuroinformatics Group at CITEC with a focus on manual interaction and tactile sensors; **Dr. Till Bovermann** is a post-doctoral researcher at Aalto University, Helsinki and received a PhD at CITEC.

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