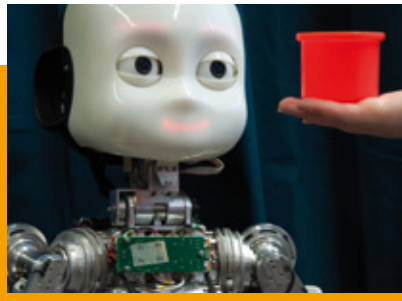
CITEC Newsletter

I/2010

Universität Bielefeld

CITEC
Cognitive Interaction Technology
Center of Excellence
Bielefeld University



Dear Readers,

Enhancing technology to better cope with tomorrow's challenges will be a key factor for our success. While approaching many limits of natural and economic ressources, we remain blessed with a steadily increasing abundance of storage density and processing power of ever more advanced computer devices.

However, the value of these raw information processing materials will crucially depend on our ability to forge them into useful support for our daily lives and for the competitiveness of our products. To contribute towards that challenge, the Excellence Cluster Cognitive Interaction Technology (CITEC) at Bielefeld University has established an interdisciplinary network of groups and projects focused on the shared goal of elucidating principles and structures for the emergence of cognitive interaction between artificial systems and humans.

Initiated in late 2007 within the German Excellence Initiative, CITEC now comprises more than 30 affiliated groups working tightly together in the areas of motion intelligence, attentive systems, situated communication and memory & learning. With this newletter issue we wish to start a sequence informing quarterly about what happens at CITEC. This time, we will report on a new CITEC group devoted to shaping massively parallel chip systems towards the needs of cognitive systems, recent results of CITEC researchers on the design of emotional affect for articial partners, and CITEC research on action recognition using acoustic packagings. Hoping that you may enjoy this new window into CITEC,

sincerely yours Helge Ritter, Coordinator

CITEC NEWS

▸ From June 8–11, CITEC will be attending the AUTOMATICA Trade Fair in Munich for the first time. Various exhibits will present current research on robotics and human-machine interaction. (Hall A2 Stand 540)

▸ In May, M. Mathieu J. Weiss, the embassy counselor and head of science and technology at the French Embassy in Berlin, visited the Cluster of Excellence on a fact-finding mission. Possible cooperations with French institutes were discussed.

▸ Funding extended for the Collaborative Research Center "Alignment in Communication." The German Research Foundation has approved a further four years of funding for this SFB 673. It will be studying processes of alignment in communication as an innovative alternative to traditional theories of human communication.

▸ Professor Helge Ritter has been made a member of the NRW-Akademie der Wissenschaften und der Künste [North Rhine-Westphalia Academy of Science and the Arts].

▸ CITEC is supporting the 17th International Conference on "Knowledge Engineering and Knowledge Management" (EKAW) in Lisbon from October 11–15, 2010. The conference will be focusing on methods for acquiring and representing knowledge.

▸ The Research Group "Challenges to the Image of Humanity and Human Dignity by New Developments in Medical Technology" at the Bielefeld Center for Interdisciplinary Research visited CITEC to discuss ethical challenges arising from advances in robotics.

▸ Prof. Steil gave an Invited Talk to celebrate the inauguration of the Cluster of Excellence "Center of Human-Friendly Robotics Based on Cognitive Neuroscience" in Osaka.

▸ CITEC extends a warm welcome to two new colleagues: Professor Barbara Hammer, Theoretical Informatics; and Junior Professor Jacob Engelmann, Active Sensing Group.

▸ **http://www.cit-ec.de/news**

Bielefeld robotics strengthens its position in Europe: 4 million Euro in external funding for Bielefeld University. Scientists at Bielefeld are participating in the following EU projects: ITALK – Integration and Transfer of Action and Language Knowledge in Robots • **AMARSI** – Adaptive Modular Architectures for Rich Motor Skills • **HUMAVIPS** – Humanoids With Auditory and Visual Abilities in Populated Spaces • **MONARCA** – Monitoring, Treatment, and Prediction of Bipolar Disorder Episodes • **MONNET** – Multilingual Ontologies for Networked Knowledge • **RobotDoC Collegium** – ROBOTics for Development of Cognition • **openAIRE** – Open Access Infrastructure for Research in Europe

On Simulating Affect to Achieve Believable Interactivity of Artificial Partners

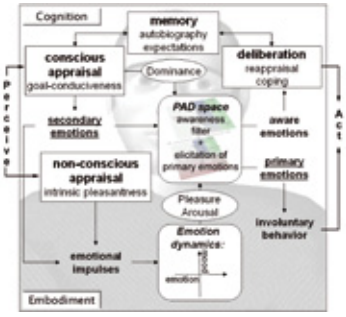
Will machines ever be emotional? Will their artificial nature not limit them to acting "as-if" they were emotional? What does it mean to "have" emotions?

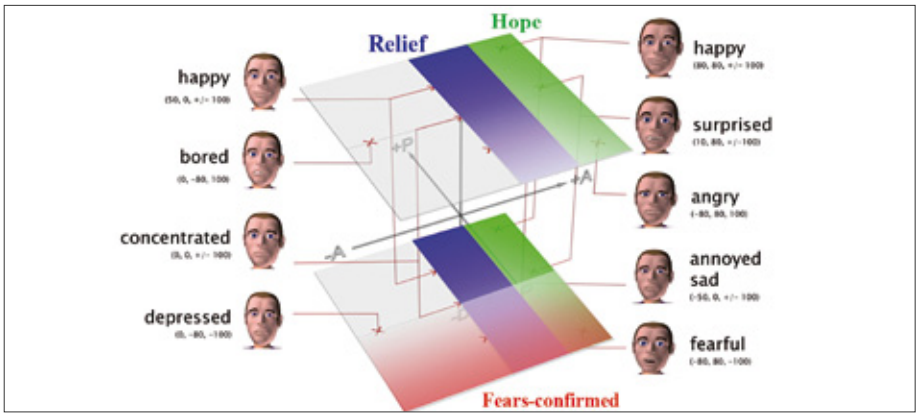
Motivated by the vision of a world in which android robots are an integral part of our society, serving, comforting, and entertaining us with a smile, the above questions framed the development of a computational architecture for the simulation of affect, named WASABI. WASABI is the result of a cooperation between CITEC researcher Ipke Wachsmuth and his colleague Christian Becker-Asano currently at the Intelligent Robotics and Communication Laboratories of the ATR Institute in Kyoto, Japan. The goal of the two scientists was to realize a computational "emotion engine" that can add "social believability" to the interaction of a wide range of artificial agents or avatars with humans. The virtual human MAX developed in Wachsmuth's group allows to gain a first-hand experience of WASABI. WASABI has become part of MAX's cognitive architecture and its adequateness has been evaluated in two empirical studies. Thanks to WASABI the virtual human MAX can entertain visitors of the Heinz-Nixdorf computer museum in Paderborn, Germany, with its ability to react emotionally during small talk conversation.

In a recent publication [1] the two researchers present the results of their empirical study and demonstrate that their WASABI MAX system can replicate an interesting range of behaviors that are well in line with current emotion-theoretical assumptions. Together with a detailed account of the rationale for distinguishing primary and secondary emotions—a conception derived from psychological as well as neuro-biological theories—the authors explain how they achieved a simulation of an emotion dynamics in a three-dimensional emotion space that assures mood-congruent elicitation of emotions. Their contribution is a cutting edge example of the complexity of computational emotion simulation and shows how the WASABI architecture supports the believability of the virtual human MAX and contributes to the ongoing interdisciplinary quest of answering fundamental questions concerning human emotions.

[1] Becker-Asano, C. & Wachsmuth, I. (2010). *Affective computing with primary and secondary emotions in a virtual human*. Autonomous Agents and Multi-Agent Systems, 20 (1), 32-49.

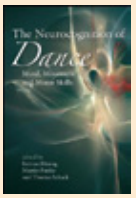
Prof. Dr. Ipke Wachsmuth is head of the Artificial Intelligence Group at CITEC/Bielefeld University; **Dr. Christian Becker-Asano** is currently working at the Intelligent Robotics and Communication Laboratories of the ATR Institute in Kyoto.





▶ Books

The Neurocognition of Dance
Mind, Movement and Motor Skills
Bettina Bläsing, Martin Puttke, Thomas Schack. Eds.

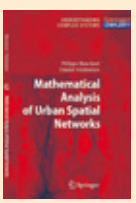


Dance has always been an important aspect of all human cultures, and the study of human movement and action has become a topic of increasing relevance over the last decade, bringing dance into the focus of the cognitive sciences. This book discusses the wide range of interrelations between body postures and body movements as conceptualised in dance with perception, mental processing and action planning.
ISBN: 978-1-84872-024-4
Publisher: Psychology Press/Routledge

Human Centered Robot Systems
Cognition, Interaction, Technology
Helge Ritter, Gerhard Sagerer, Rüdiger Dillmann, Martin Buss. Eds.

Human Centered Robotic Systems must be able to interact with humans such that the burden of adaptation lies with the machine and not with the human. A survey of recent approaches, the current state-of-the-art, and possible future directions in this interdisciplinary field is presented.
ISBN: 978-3-642-10402-2
Publisher: Springer

Mathematical Analysis of Urban Spatial Networks
Philippe Blanchard, Dimitri Volchenkov

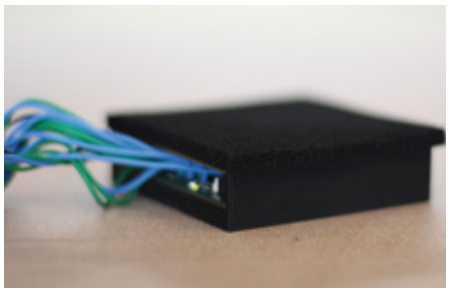


"We shape our buildings, thereafter they shape us,"—said Sir Winston Churchill. In their book "Mathematical Analysis of Urban Spatial Networks", Blanchard and Volchenkov discuss how the built city elements create the space that people then use—urban spatial networks and their impact on poverty and environments.
ISBN 978-3-540-87828-5
Publisher: Springer

New Sensor for Slip-Detection

New sensors can add important dimensions to cognitive interaction with technical systems. For haptic/tactile perception, one challenge is the integration of static and dynamic sensing. Combining a novel, very fast piezo-resistive tactile sensor developed by CITEC researcher Carsten Schürmann with a neural network, Schöpfer et al. [1] were now able to combine the detection of incipient slip with the ability to discriminate different surface textures within a single sensing mechanism. Their approach is being presented at a presentation at ISR/Robotik 2010 Munich.

[1] M. Schöpfer, C. Schürmann, M. Pardowitz, and H. Ritter. *Using a Piezo-Resistive Tactile Sensor for Detection of Incipient Slippage*, International Symposium on Robotics, 07/06/2010, Munich, Germany.



▶ Summer School

"The Structure of Cognitive Motion: From Analysis to Synthesis"—CITEC Graduate School announces the inaugural Summer School for 2010

Excellent PhD students are invited to participate in the first CITEC summer school, taking place from **6–11 September** at Bielefeld University. Members of the virtual faculty will contribute with lectures and keynote talks.

The summer school will bring together young researchers from all CITEC related disciplines, that share an interest in the topic of motion and cognition.

We invite electronic applications until **Monday 28 June 2010** under:
www.cit-ec.de/summerschool/

Research Group: Cognitronics and Sensor Systems

The group started in October 2009 and is led by Prof. Ulrich Rückert. Before joining the CITEC, Ulrich Rückert was Professor at the Heinz Nixdorf Institute (1995–2009), University of Paderborn, and at the Technical University of Hamburg-Harburg (1993–1995). In 2001, he was appointed Adjunct Professor of the Faculty of Information Technology, Queensland University of Technology, Brisbane, Australia.

His main research interests are bio-inspired architectures for nanotechnologies and cognitive robotics. In 2008, he received the first Innovation Award of Northrhine-Westphalia, Germany (together with Prof. Noé, University of Paderborn), for achievements in the field of optical communication. He is chairman of the national special interest group "Microelectronics for neural networks" of the ITG (German Information Technology Society) and founding member of the AMiRE (Autonomous Minirobots for Research and Edutainment) Symposium.

Research Interest

The systematic design of resource-efficient microelectronic systems and their use according to specific application demands constitute the central research aim of the research group "Cognitronics & Sensor Systems". A special focus lies on massively parallel, reconfigurable computing architectures and on the evaluation of their resource-efficiency in concrete applications. In this context, the transfer of biological information processing principles into technical systems is of special interest.

Current Research Activities

- Design of ultra low power embedded processor cores
- Design of massively parallel system on chip multiprocessor for network processors, baseband processors, cognitive systems
- Design of dependable, reconfigurable architectures based on FPGAs and multiprocessors
- Rapid-Prototyping and Hardware-in-the-Loop for system design
- Cognitive sportswear and automatic analysis of team sports
- Autonomous mini-robots for research and edutainment
- Cooperation in human-robot teams

Collaborations

- Dept. of Electrical and Computer Engineering, Rice University, Houston, Texas
- Faculty of Computer Science, Ain Shams University, Cairo, Egypt
- Faculty of Information Technology, Queensland University of Technology, Brisbane, Australia
- Heinz Nixdorf Institute, University of Paderborn, Germany
- Paderborn Center of Parallel Computing, University of Paderborn, Germany
- Kirchhoff Institut für Physik, Heidelberg University, Germany
- Nanoelectronics Group, Department of Informatics, University of Oslo, Norway
- Christmann Informationstechnik & Medien, Ilsede, Germany
- Comneon, Nürnberg, Germany
- dSPACE Corp., Paderborn, Germany
- Lantiq Corp., München, Germany
- Infineon Technologies, München, Germany

Acoustic Packaging

Adult in tutoring situation.

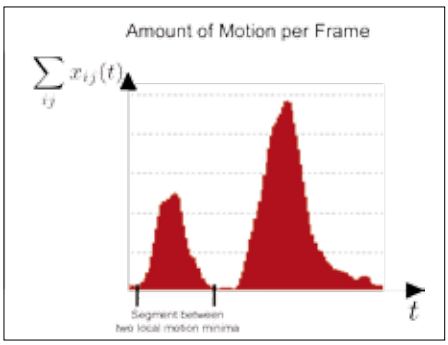
Even in the most complex and continuous stream of action humans still can relate single actions to their overarching activities . Washing hands, for example, is embedded in going from somewhere to the bathroom, opening the door, turning the water on, touching a bar of soap, rubbing the hands under the water, turning the water off, and grasping the towel. For adults, it is an easy task to decide which action sequences are meaningful and necessary for hand washing activity (like rubbing the hand under the water) and which not (like opening the door). But for a child or a socially interactive robot, it is a challenge to find out the appropriate interpretation of a sequence and to decide whether it belongs to the event or not. But how do children acquire the needed understanding of an activity and its individual sequences? And how can we realize a similar learning capability for robots?

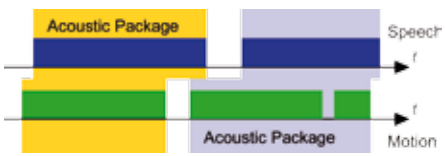
Researchers in CITEC believe that an important key lies in the social environment helping the infant in recognizing which action sequences are meaningful and necessary. For example parents talk about their actions while demonstrating them to their child. If we look at the information the child's senses perceive, we observe that the action sequence is described in a redundant way: Both, the visual information (e.g. movement of the objects) and acoustic information (e.g. accompanying narration) describe the same action sequence. This redundancy helps infants to attend to the relevant parts of the demonstration and to find structure within them. For example, when parents describe an action, this overlapping narration can help the infants to identify larger units in the action sequence, which belong together. This process has been termed acoustic packaging.

To test how much acoustic packaging can contribute to action understanding, CITEC researchers Lars Schillingmann, Britta Wrede and Katharina Rohlfing have developed a computational model of acoustic packaging [1]. They implemented their model on a robot enabling it to automatically find acoustic packages in the stream of sensory information. This allowed them to investigate how this capability facilitates for the robot to learn from human demonstrations. Their idea is to find segments both in the acoustic information and in the visual information the robot perceives. These segments are then associated to acoustic packages. To segment the visual input their model analyzes temporal changes in the signal. If for example a cup is moved it would lead to a peak in the amount of visual change over time, marking a potential segmentation boundary for the visual input.

The acoustic input is segmented using a speech recognizer which segments the signal into speech and non speech segments. The segments from both modalities are associated based on their temporal relationship. If both speech and visual segments temporally overlap, an acoustic package is formed containing these segments.

Their research showed that acoustic packages can be very useful for early action understanding. Early learning units formed in this way can further be processed by other modules that infer models about the actions currently presented. Additionally, acoustic packages appear very promisingas a vehicle for feedback behavior in human-robot tutoring situations. In their current research, the authors now investigate how acoustic packages can help to provide for the tutors some insights into the robot's processing. For example to which parts of an action demonstration the robot is attending to.





[1] L. Schillingmann, B. Wrede, and K. J. Rohlfing. (2009). *A computational model of acoustic packaging*. IEEE Transactions on Autonomous Mental Development, vol. 1, no. 4, pp. 226–237.

Dipl. Inform. Lars Schillingmann is currently working in the EU-Project iTalk on the topic of Acoustic Packaging.
Dr.-Ing. Britta Wrede is head of the Hybrid Society Group at the Research Institute for Cognition and Robotics (CoR-Lab).
Dr. phil. Katharina J. Rohlfing is head of the Emergentist Semantics Group within Center of Excellence Cognitive Interaction Technology.

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