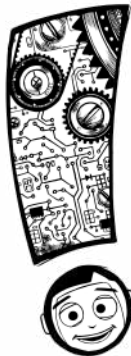


# CITEC Summer School 2011

## Mechanisms of Attention: From Experimental Studies to Technical Systems

CITEC, Bielefeld University  
3 – 8 October 2011





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Prof. Dr. Franz Kummert – Deputy Head of the Graduate School – Applied Informatics

Prof. Dr. Werner Schneider – Neurocognitive Psychology

Prof. Dr. Prisca Stenneken – Clinical Linguistics

Dr. Hendrik Koesling – Neuroinformatics

Dr. Dirk Koester – Neurocognition and Action

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# welcome to CITEC

Dear Attendees,

Welcome to CITEC!

The Center of Excellence Cognitive Interaction Technology (CITEC) was founded at Bielefeld University as part of the Excellence Initiative of the German Federal Government and the state government.

CITEC researchers strive to create interactive devices that can be operated easily and intuitively, ranging from everyday tools to autonomous robots. To achieve such a challenging goal, a system needs to be endowed with the corresponding cognitive abilities. The technology of the future should adapt itself to its human users, rather than forcing humans to learn and exercise the often cumbersome operation of the current equipment, therefore moving part of the cognitive load from the user to the system. Just as every human being automatically understands the behaviour of his/her partners, technological systems should be able to detect and interpret the attentional state and the actions of the operator and adjust their response to suit his or her different needs and intentions. Such high-level capabilities call for collaboration between cognitive, natural and social sciences, in order to study the fundamental architectural principles of cognitive interaction – be it between humans or in human-machine interaction. This necessary and pioneering scientific effort builds incrementally on an understanding of perception and action, language and memory and on their functional modeling for artificial systems.

The multiplicity and diversity of attention mechanisms is a theme that combines basic research with technological applications in order to significantly advance our understanding of cognition itself through intense interdisciplinary cooperations. Ideally, this involves drawing on the experience and expertise of researchers from many different backgrounds and cultures. We hope the CITEC Summer School Series will have a key role to play in fostering these cooperative ventures, and hence the school is intended to promote exchange and collaboration between young researchers from all over the world. On behalf of the organising committee, we welcome you to Bielefeld and hope you have a productive and exciting stay!

# schedule

## Schedule, 03.10 - 08.10

	Monday 3.10	Tuesday 4.10	Wednesday 5.10	Thursday 6.10	Friday 7.10	Saturday 8.10 (start at 10.00)
Normal Time						
Tues/Thurs Time						
09.00 - 10.00		<b>Anissar</b>	<b>Logan</b>	<b>Williams</b>	<b>Deco</b>	<b>Tsotsos</b> 10.00 - 11.00
10.00 - 10.30		Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break
10.30 - 11.30		Discussion Session	Discussion Session	Discussion Session	Discussion Session	Discussion Session 11.30 - 12.30
11.30 - 12.30		Practical Module I	Lunch	Practical Module V	Lunch	Lunch
12.30 - 14.30		Lunch	Practical Module III	Lunch	Practical Module VII	
14.30 - 15.00		<b>Ballard</b>	Coffee Break	<b>Hayhoe</b>	Coffee Break	<b>Departure</b>
15.30 - 16.00	<b>Arrival</b>	Coffee Break	Practical Module IV	Coffee Break	Practical Module VIII	
15.00 - 17.00	<b>Official Welcome</b>	Discussion Session		Discussion Session		
17.00 - 19.00	<b>Poster Session</b>	Practical Module II	<b>Official Dinner (Glück und Seligkeit)</b>	Practical Module VI		<b>Dinner + Farewell Party</b>
19.00 - late	<b>Barbeque</b>	Dinner + free time		Dinner + Social/activity evening		



# schedule

## Modules

	Tuesday 04.10		Wednesday 05.10		Thursday 06.10		Friday 07.10	
<b>Stream 1:</b> Mechanisms of Active Exploration and Multisensory Integration	<b>Module 1:</b> 11.30 - 13.30 Lectures/Lab Tours (Volker Dür, Jacob Engelmann, Merik Ernst) W-132	<b>Module 2:</b> 17.00 - 19.00	<b>Module 3:</b> 13.30 - 15.30 Tactile Exploration in Insects (Volker Dum) W1-132	<b>Module 4:</b> 16.00 - 18.00	<b>Module 5:</b> 11.30 - 13.30 Attentional Modulation during Human Locomotion (Mark Ernst) W3-201	<b>Module 6:</b> 17.00 - 19.00	<b>Module 7:</b> 13.30 - 15.30 Sensory Exploration in Electric Fish (Jacob Engelmann) N7-117	
<b>Stream 2:</b> Attentional Mechanisms in Language Processing and Communication	<b>Introduction</b> (Michele Buringo, Hendrik Buschmeier, Sascha Griffiths, Helene Keyssa, Ramin Yaghoobzadeh) H1-128		<b>Eyelink 1000 Experiments</b> (Michele Buringo, Sascha Griffiths, Helene Keyssa) 10-133		<b>Modelling user gaze in human-robot interaction</b> (Hendrik Buschmeier, Ramin Yaghoobzadeh) H1-103 & H1-116		<b>Markers of user attention, and discussion.</b> (Michele Buringo, Hendrik Buschmeier, Sascha Griffiths, Helene Keyssa, Ramin Yaghoobzadeh) H1-128	
<b>Stream 3:</b> Structuring and Coordinating Attention	<b>Development of attention mechanisms</b> (Katharina Rohlfing) Q2-138		<b>Joint Attention in Augmented Reality based collaboration</b> (Thomas Hamann, Karola Plösch, Christian Schmeier, Alexander Neumann) Q0-119/Q0-		<b>How does a robot experience the world?</b> (Annika Peters, Andreas Kipp) Q0-114		<b>Computational modelling of visual attention</b> (Kathrin Lohan, Vikram Narayan) N5-21	
<b>Stream 4:</b> Motion and Attention	<b>Focus of Attention</b> (Billy Land, Philipp Gullspörring, Philipp) W01-182	<b>EEG</b> (Dirk Koester, Iris Gullspörring) N3-119	<b>Cognitive control in manual action</b> (Robert Haschke) Q1-102		<b>Motor Learning and control</b> (Tino Stobbe) N3-117	<b>Speed-stacking</b> (Rebecca Friesler, Kai Essig, Frank Lahtinen) Q1-101	<b>Hand motion capture</b> (Jonathan Maycock) Q1-128	<b>Models of Visual Attention</b> (Arno Brandt) Q1-102



# stream and module abstracts

## **Stream 1 – Mechanisms of Active Exploration and Multisensory Integration**

How do animals and humans actively explore their environment? What part of their sensory infrastructure do they employ? How do multi-modal sensory systems act together?

In this stream, participants will carry out experiments on humans, insects and electric fish, addressing different issues of context-dependent, active exploration. The experiments will provide an inside view into the latest methodology applied to the field of active sensing and sensory integration.

### **Modules 1 & 2 – Lectures and Lab tours**

Volker Dürr, Jacob Engelmann & Marc Ernst

Tuesday, 11.30–1.30 p.m. & 5.00–7.00 p.m.

The first module will be an introduction in the field of active sensing and sensory integration with short lectures in each field and additional lab tours through the departments of Biological Cybernetics (Dürr), Active Sensing (Engelmann) and Cognitive Neuroscience (Ernst).

### **Modules 3 & 4 – Context-Dependent Adaptation of Tactile Exploration in Insects / Analysis of Active Tactile Sampling Patterns: the Role of Object Features**

Volker Dürr

Wednesday, 1.30–3.30 p.m. & 4.00–6.00 p.m.

This part of the course will focus on active tactile searching and sampling strategies in animals, particularly in insects. Insects employ their antennae, a pair of dedicated sensory limbs that is mounted to the head, for tactile exploration of the near range. We are interested in how insects selectively sample, i.e., attend to, spatial object features. The course offers two optional experimental sessions on tactile exploration in insects: (1) the context-dependent adaptation of antennal movements in stick insects and (2) the analysis of active tactile sampling of objects in honeybees.

## steam and module abstracts

Participants will apply two different motion capture techniques, and address questions such as (1) how does the temporal coordination of multiple joints translate into spatial coordination of sampling ranges, or (2) how do object features affect the sampling strategy.

### **Modules 5 & 6 - Sensory Exploration of Novel Objects and Object Recognition in Electric Fish**

Jacob Engelmann

Thursday, 11.30-1.30 p.m. & 5.00-7.00 p.m.

Participants will have the chance to work on two independent projects on actively sensing weakly electric fish. One project focuses on the context dependent manner in which these fish actively acquire electrosensory information by regulating the sampling interval. The second project explores the impact of ego-motion on the sensory input. Techniques applied: video tracking and trajectory analysis, acquisition of electric signals and their analysis.

### **Modules 7 & 8 - Attentional Modulation of Multisensory Integration during Human Locomotion**

Marc Ernst

Friday, 1.30-3.30 p.m. & 4.00-6.00 p.m.

Humans combine information from all their senses in order to successfully interact with the environment. In this module I will discuss the different combination strategies used by the human brain to make the most efficient use of such multisensory information. Specifically, I will focus on probabilistic models of integration and learning. We will then conduct an experiment investigating human locomotion behavior while manipulating the amount of information available to the human brain.

## stream and module abstracts

### **Stream 2 - Attentional mechanisms in language processing and communication: from humans to virtual agents**

The following stream will provide an introduction to the role of visual attention in language processing and communication. Methodological approaches to visual attention will be illustrated, focussing in particular on eye-tracking applications; participants will be given the opportunity to get practical hands-on experience with state of the art eye trackers (Eye Link 1000, SeeingMachines, FaceLab) in different application domains. The first part of the course focuses on investigating of how listeners process sentences in a given visual context. Participants will learn the basics of running psycholinguistic experiments and analysing eye-tracking data. The second part of the course then looks at the role of visual attention in face-to-face dialogue and at how interlocutors' gaze behaviour can be analysed in real-time and modelled computationally for human-agent interaction. Participants will learn how to process gaze data as soon as it is produced by the eye tracker, how to interpret it, and how a virtual agent's reactions can be modelled.

#### **Modules 1 & 2 - Introduction**

Michele Burigo, Hendrik Buschmeier, Sascha S. Griffiths, Helene Kreysa & Ramin Yaghoubzadeh

Tuesday, 11.30-1.30 p.m. & 5.00-7.00 p.m.

This module will provide a theoretical introduction to the stream, focussing on visual attention in language processing and face-to-face communication. This will be followed by a practical session, gathering experimental data with the EyeLink 1000 eyetracker.

# stream and module abstracts

## **Modules 3 & 4 - Eye-tracking data analysis**

Michele Burigo, Sascha S. Griffiths & Helene Kreysa

Wednesday, 1.30-3.30 p.m. & 4.00-6.00 p.m.

In this module, we will continue collecting data and discuss how to analyse fixation patterns using SR DataViewer. This includes an introduction to statistical analysis methods.

## **Modules 5 & 6 - Applying eye-tracking to interactive system**

Hendrik Buschmeier & Ramin Yaghoubzadeh

Thursday, 11.30-1.30 p.m. & 5.00-7.00 p.m.

In this module we will model user gaze in human-agent interaction. We will track the user's gaze while interacting with the virtual conversational agent "Billie". We will also analyse it in real-time and let Billie react to it.

## **Modules 7 & 8 - Beyond eye-tracking & Final discussion**

Michele Burigo, Hendrik Buschmeier, Sascha S. Griffiths, Helene Kreysa & Ramin Yaghoubzadeh

Friday, 1.30-3.30 p.m. & 4.00-6.00 p.m.

In the final module we will look at markers of user attention that go beyond gaze behaviour (e.g., vocal-verbal feedback, head gestures and facial expressions). We will conclude this stream with a discussion of current research results and future research perspectives, including thoughts on modelling visual attention at the interface between communicative and non-communicative situations.

# stream and module abstracts

## Stream 3 – Structuring and Coordinating Attention

This stream examines attention from several perspectives. There will be modules which investigate the ways in which attention mechanisms develop in human infants within situated contexts and natural interactions. Further modules will examine alignment in AR-based scenarios. There will also be modules which look at attention from a robots perspective.

### Modules 1 & 2 – Educating attention in early social interaction

Katharina Rohlfing, Iris Nomikou & Joanna Znajdek

Tuesday, 11.30–1.30 p.m. & 5.00–7.00 p.m.

These modules aim at investigating the ways in which attention mechanisms develop within situated contexts and natural interactions. More specifically the focus lies in analyzing the ways in which young infants' perception is educated through social interactions with their caregivers. It will introduce participants to working with natural interaction data. Using an existing corpus of video data, comprising longitudinal recordings of interactions of mothers with their preverbal infants, the participants will learn to use qualitative micro-analytical methods of interaction analysis to systematically describe the strategies that mothers use to recruit, maintain, direct and reward infants' attention and the modalities involved in such attention educating practices. A further central question will be how this behavior is adapted to the evolving perceptual capacities of the infant, i.e. how it is modified as the infant develops.

## stream and module abstracts

### **Modules 3 & 4 – Structuring and coordinating attention in augmented reality**

Thomas Hermann, Karola Pitsch, Christian Schnier & Alexander Neumann

Wednesday, 1.30–3.30 p.m. & 4.00–6.00 p.m.

In our project, AR-based cooperation serves as basis for the investigation of alignment in communication, allowing (a) the direct multimodal interception of users (b) highly controlled and even asymmetric manipulation of stimuli, (c) the introduction of signals to support alignment and joint attention in otherwise impossible ways. The goal is to gain a better understanding of how attention and alignment interplay to structure cooperation. This is achieved by observing alignment under regular, disturbed and enhanced joint attention, both realized by means of our AR-techniques. This novel approach was developed to bring together qualitative approaches (Conversation Analysis) and quantitative approaches (Data Mining) for the study of joint attention and alignment, yet we see more potential of this Interception & Manipulation approach in other attention research, which we would like to explore with the attendees of the workshop.

### **Modules 5 & 6 – Computational modeling of visual attention**

Kathrin Lohan & Vikram Narayan

Thursday, 11.30–1.30 p.m. & 5.00–7.00 p.m.

This module consists of a 4 hour joint session comprising a lecture + practical session. In the field of computational modeling of visual attention many different saliency system approaches have been proposed and quantified in terms of speed, quality and other technical issues. In this course we will compare and discuss 3 different saliency systems to give an insight into state-of-the-art visual attention ideas.

# stream and module abstracts

## **Modules 7 & 8 - How a robot sees the world**

Annika Peters & Andreas Kipp

Friday, 1.30-3.30 p.m. & 4.00-6.00 p.m.

In this workshop the viewpoint of a robot will be experienced. What types of information does a robot receive? How can this information be combined to generate actions or focus the robots attention? During the workshop small interdisciplinary teams will discover different components of robotic attention and combine them with each other. To give a realistic introduction as to which information a robot receives during interaction, all teams will work together in a Wizard-of-Oz scenario to fulfil a given task with the robot in interaction. No programming expertise is needed for the workshop because all information will be accessible via tablet pc.

## **Stream 4: Motion and Attention**

Attention for perception and movement - from experimental studies to moving systems. Attending to dynamic scenes and motor control are key cognitive capabilities enabling human and artificial agents to make sense of their environments and of occurring events and to plan the proper motor response for the task at hand. The stream provides insights into recent experiments revealing information about human attention using motion analysis with high-speed-motion-tracking system, EEG, eyetracking studies and augmented reality systems. The stream contains interweaved modules on formal modeling of motion patterns, computational modeling of attention as well as their implementation on two-handed robot systems to analyze the role attention plays in human and artificial motion.



# stream and module abstracts

## **Module 1: Focus of Attention on Motor Performance: From Theory to Analyses**

William Land & Philipp Philippen

Tuesday, 11.30–1.30 p.m.

In recent years, a considerable amount of research has been conducted to elucidate the effects of attentional focus on task performance (e.g., Castenada & Gray, 2007; Wulf, 2007). From this research, proper allocation of limited attentional resources has been explicitly linked to improved learning and outcome performance (e.g., Wulf, 2007). The aim of this module is to introduce participants to the main theoretical accounts governing attentional focus effects, while also introducing participants to various levels of analyses (e.g., outcome, biomechanical, and EMG) concerning the impact of attention on performance.

## **Module 2: EEG – Influence of attention on brain activities**

Dirk Koester & Iris Güldenpenning

Tuesday, 5.00–7.00 p.m.

In this module a short introduction into electroencephalography and the event-related brain potential (ERP) technique will be provided. Participants will also acquire hands-on knowledge in EEG recordings. In a short experimental session, we will demonstrate how attention influences particular ERP components.

## **Modules 3 & 4: Cognitive Control in Manual Action**

Robert Haschke

Wednesday, 1.30–3.0 p.m. & 4.00–6.00 p.m.

Hand movement during grasping and object manipulation is influenced by many visual features, such as size, shape and weight – but also by concepts of the object; its purpose, affordances and features, and the intended actions. Basic grasp types can be distinguished which represent concept formation on the level of manual action. We investigate grasping from the point of view of biomechanics, attention and cognition, by analysing interactions between hand movements, object representations and action

## stream and module abstracts

planning. We then look at transferring the acquired motor concepts to a real robot system. Based on psychologically motivated concepts for the representation of grasping motions, we propose a strategy for grasp realisation suited to a real robot comprised of two anthropomorphic hands. Participants will implement and test this grasping strategy using a virtual simulation environment. Successful implementations will be evaluated on the real robot system.

### **Module 5: Motor learning and control with real-time (online) feedback**

Tino Stöckel

Thursday, 11.30-1.30 p.m.

Within the module we will show how an augmented reality set-up can be implemented in motor control and learning to provide participants with real-time feedback of their performance. Thereby different sources of information can be used to optimize the performance depending on the given information via the Headmounted display. The task will be a simple finger movement, where participants are required to realize a predefined distance (aperture) between two fingers.

### **Module 6: Looking – Acting – Learning in Speedstacking: Measuring Eye Movements in a Natural Bimanual Task**

Rebecca Förster, Kais Essig & Frank Lehmké

Thursday, 5.00-7-00 p.m.

Modern mobile eye-tracking systems record participants' gaze behavior while they move freely within the environment and have haptic contact with the objects of interest. These systems allow investigating the perceptual processes during active tasks. Thereby, insights can be gained about the information our eyes supply to the brain and that is used to control our limbs ("eyes are a window to the mind"). This module will give a short introduction to visual perception and sensorimotor control in natural tasks. Then, a mobile eye-tracking system will be used to record participants' eye movements during a bimanual, high-speed stacking task.

# stream and module abstracts

Finally, we will demonstrate how the recorded eye movements can be analyzed to investigate how participants individually adjust their attentional focus and motions in such a complex sensorimotor task.

## **Module 7: Approaching Manual Intelligence**

Jonathan Maycock

Friday, 1.30-3.30 p.m.

In this module you will learn about how to set up a sophisticated laboratory for capturing detailed hand movements. The Manual Intelligence Lab (MILAB) consists of 14 Vicon cameras and various other devices (Swiss ranger, Basler cameras, tactile book, Cybergloves etc.) within a small area that can capture hand movements at levels of high spatial and temporal coherence. Details of synchronisation issues, the created interface to the database and research thus far carried out in the lab will be provided. There will also be a chance to design and carry out an experiment.

## **Module 8: Computational Models of Visual Attention**

Anna Belardinelli

Friday, 4.00-6.00 p.m.

Computational models of attention have gained a major role in vision architectures in the last years. Every visual task can indeed hugely benefit from the filtering of the visual input and the selection of regions and objects of interest for further, more specific processing. In this module we will review the most established models and mechanisms of computational attention, with a special focus on biologically inspired systems. We will apply some of them to images and video sequences in order to gain insights on the importance of different features, bottom-up and top-down factors, location- and object-based approaches for the selection of the next focus of attention for the task at hand.

## speakers



**Prof. Dr. Ehud Ahissar**

Department of Neurobiology

Weizmann Institute of Science – Israel

Ehud Ahissar is a Professor of Neurobiology at the Weizmann Institute of Science, Rehovot, Israel. He holds the Helen Diller family professorial chair in Neurobiology. He earned a BSc in Electrical Engineering from Tel Aviv University, and his PhD in Neurobiology at the Hebrew University– Hadassah Medical School, Jerusalem with the thesis "Examination of models for learning in behaving monkey's cortex". He did his Postdoctoral Fellowship in Neurophysiology, at the Department of Neurobiology, Weizmann Institute of Science, Rehovot. His research focuses on neuronal mechanisms of adaptive perception with a special emphasis on active sensing via closed loops.

By applying principles of engineering and neurobiology, Ahissar and his colleagues are trying to understand the operation of, and the processes underlying the emergence of perception in the rodent whisking system. Rats, like some other rodents, possess a specific system for active touch that uses the long facial whiskers (vibrissae) to gather information about the immediate environment. The main effort of his laboratory is aimed at deciphering the neuronal mechanisms that underlie vibrissal touch. Additional efforts in his laboratory are dedicated to studying active touch and active vision in humans. The latter are guided by detailed neuronal knowledge accumulated in the rat, with the eventual goal of developing efficient tactile substitutions for the blind.

# speakers

## Keynote Talk:

### "Closed loop perception of object location"

Objects can be localized by whisking rats with a hyperacuity precision. This process takes several iterative whisking cycles in which the rat palpates the objects. I will describe the motor-sensory encoding process underlying object localization, possible mechanisms for recoding by central (mostly thalamocortical) circuits, and characteristics of motor-sensory loop behavior. I will argue, and present data from whisking humans suggesting that perception of object location emerges from a convergence process that lasts a few motor sensory cycles. These data can serve as a basis for an open discussion about perception being 'direct', 'indirect', or 'looped'.

## speakers



### **Prof. Dr. Dana H. Ballard**

Department of Computer Science

University of Texas at Austin – USA

Dana H. Ballard obtained his undergraduate degree in Aeronautics and Astronautics from M.I.T. in 1967. Subsequently he obtained MS and PhD degrees in information engineering from the University of Michigan and the University of California at Irvine in 1969 and 1974 respectively. He is the author of two books, *Computer Vision* (with Christopher Brown) and *An Introduction to Natural Computation*.

His main research interest is in computational theories of the brain with emphasis on human vision. His research places emphasis on Embodied Cognition. Starting in 1985, he and Chris Brown designed and built the first high-speed binocular camera control system capable of simulating human eye movements in real time.

Currently he pursues this research at the University of Texas at Austin by using model humans in virtual reality environments. His current focus is on the use of machine learning as a model for human behavior with an emphasis on reinforcement learning.

# speakers

## Keynote Talk:

### "Virtual Environments for the study of Embodied Cognition"

The intrinsic complexity of the brain can lead one to set aside issues related to its relationships with the body, but the field of Embodied Cognition stresses that understanding of brain function at the system level requires one to address the role of the brain-body interface. While it is obvious that the brain receives all its input through the senses and directs its outputs through the motor system, it has only recently been appreciated that the body interface performs huge amounts of computation that does not have to be repeated by the brain, and thus affords the brain great simplifications in its representations. In effect the brain's abstract states can explicitly or implicitly refer to extremely compact abstractions of the world created by the body.

Even given such abstractions, the severe speed limitations in its neural circuitry means that vast amounts of indexing must be performed during development so that appropriate behavioral responses can be rapidly accessed. One way this could happen would be if the brain used some kind of decomposition whereby behavioral primitives could be quickly accessed and combined. Such a factorization has huge synergies with embodied cognition models, which can use the natural filtering imposed by the body in directing behavior to select relevant primitives. These advantages can be explored with virtual environments replete with humanoid avatars. The crucial advantage of VR environments is that they allow the manipulation of experimental parameters in systematic ways. Our tests use everyday natural settings such as walking and driving in a small town, sandwich making, and looking for lost items in an apartment.

Our focus centers around the programming of the individual behavioral primitives using reinforcement learning. Central issues are eye fixation programming, credit assignment to individual behavioral modules, and learning the value of behaviors via inverse reinforcement learning.

## speakers



### **Prof. Dr. Gustavo Deco**

Computational Neuroscience Group,  
Department of Technology  
Universitat Pompeu Fabra, Barcelona – Spain

Prof. Dr. phil. Dr. rer. nat. habil. Gustavo Deco is Research Professor at the Institutio Catalana de Recerca i Estudis Avanats and Full Professor (Catedrático) the Pompeu Fabra University (Barcelona) where he is head of the Computational Neuroscience group at the Department of Technology. He studied Physics at the National University of Rosario (Argentina) where he received his diploma degree in Theoretical Atomic Physics.

In 1987, he received his Ph.D. degree in Physics for his thesis on Relativistic Atomic Collisions. In 1987, he was a post doctoral fellow at the University of Bordeaux in France. In the period from 1988 to 1990, he obtained a post doctoral position of the Alexander von Humboldt Foundation at the University of Giessen in Germany.

From 1990 to 2003, he has been with the Neural Computing Section at the Siemens Corporate Research Center in Munich, Germany, where he led the Computational Neuroscience Group. In 1997, he obtained his habilitation (maximal academical degree in Germany) in Computer Science (Dr. rer. nat. habil.) at the Technical University of Munich for his thesis on Neural Learning. In 2001, he received his PhD in Psychology (Dr. phil.) for his thesis on Visual Attention at the Ludwig-Maximilian-University of Munich. He was lecturer at the universities of Rosario, Frankfurt and Munich. Since 1998 he is Associate Professor at the Technical University of Munich and Honorary Professor at the University of Rosario, and since 2001 Invited Lecturer at the Ludwig-Maximilian-University of Munich.



# speakers

Since 2001 he is also McDonnell-Pew Visiting Fellow of the Centre for Cognitive Neuroscience at the University of Oxford. In 2001 he was awarded the international prize of Siemens "Inventor of the Year" for his contribution in statistical learning, models of visual perception, and fMRI based diagnosis of neuropsychiatric diseases. His research interests include computational neuroscience, neuropsychology, psycholinguistics, biological networks, statistical formulation of neural networks, and chaos theory. He has published 4 books, more than 160 papers in International Journals, 260 papers in International Conferences and 30 book chapters. He has also 52 patents in Europe, USA, Canada and Japan.

## **Keynote Talk:**

### **"Neuronal and Synaptic Mechanisms Underlying Attention"**

Attention is a rich psychological and neurobiological construct that influences almost all aspects of cognitive behaviour. It enables enhanced processing of behaviourally relevant stimuli at the expense of irrelevant stimuli. At the cellular level, rhythmic synchronization at local and long-range spatial scales complements the attention-induced firing rate changes of neurons. The former is hypothesized to enable efficient communication between neuronal ensembles tuned to spatial and featural aspects of the attended stimulus. Recent modelling studies suggest that the rhythmic synchronization in the gamma range may be mediated by a fine balance between N-methyl-d-aspartate and a amino-3-hydroxy-5-methylisoxazole-4-propionate postsynaptic currents, whereas other studies have highlighted the possible contribution of the neuromodulator acetylcholine. This talk summarizes some recent modelling and experimental studies investigating mechanisms of attention in sensory areas and discusses possibilities of how glutamatergic and cholinergic systems could contribute to increased processing abilities at the cellular and network level during states of top-down attention.

## speakers



**Prof. Dr. Mary Hayhoe**

Department of Psychology

University of Texas at Austin – USA

Mary Hayhoe is a Professor in the Psychology Department and the Center for Perceptual Systems at the University of Texas at Austin. She did her undergraduate degree at the University of Queensland, Australia and her PhD in Psychology at the University of California at San Diego. Before moving to UT, she was at the Center for Visual Science at the University of Rochester where she served as Associate Director of the Center, and Director of the Cognitive Science Program.

She is recognized for her work on early visual processing, and more recently for her work in eye movements, attention, and working memory, particularly in natural tasks and environments. She has pioneered the use of eye tracking in virtual environments for the investigation of natural visually guided behavior in controlled settings. Her work has been funded by the NIH National Eye Institute and by the NIH Center for Research Resources.

She is on the Program Committee for Applied Perception in Graphics and Visualization (APGV) and on the Board of Directors of the Vision Sciences Society (VSS). She is a Fellow of the Optical Society and is on the Editorial Board of the Journal of Vision.

# speakers

## Keynote Talk:

### "Understanding attentional control in the context of behavior"

It will be difficult to properly understand attention without understanding how it functions in the context of natural behavior. What principles control the selection of visual information from the environment? From the results of several studies that monitor eye movements in both real and virtual environments, several principles emerge. First, both selection and storage of visual information in natural tasks depend on momentary task relevance. Thus to understand attentional control we will need to have a theory that takes into account the priority structure of natural tasks. Second, observers deal with attentional limitations by using memory representations, and do not re-attend to information that is typically stable. Thus an important determinant of attentional control may be what observers have previously learnt about the dynamic properties of the world. Third, observers are sensitive to the statistical properties of the visual scene and rapidly modify attentional allocation when changes occur. These principles provide a basis for understanding the generation of complex sequences involved in natural visually guided behavior.

## speakers



### **Prof. Dr. Gordon Logan**

Department of Psychology

Vanderbilt University,  
Nashville, Tennessee – USA

Prof. Logan got his Ph.D. from McGill University in Montreal, Canada.

He is Centennial Professor of Psychology at Vanderbilt and he is the editor in chief of Cognitive Psychology.

He is also an avid guitar player.

### **Keynote Talk:**

### **"Attention and hierarchical control of cognition and action"**

Cognition is important to survival primarily because it can be controlled. The processes that direct thought and action toward goals have been investigated intensively for the last 20 years. A common theme in the research is that cognitive control is hierarchical, with a higher-level control process controlling a lower-level subordinate process. However, the idea that cognitive control is hierarchical is very controversial. Hierarchical control explains cognitive control in several domains, including task switching and action planning, but alternative explanations that do not assume hierarchical control appear to explain the phenomena just as well. My strategy for investigating hierarchical control has been to focus on skilled typewriting, which has a high a priori likelihood of being controlled hierarchically. My goal has been to develop experimental procedures that demonstrate hierarchical control in typewriting that could be extended to demonstrate hierarchical control in other domains.

## speakers



### **Prof. Dr. John Tsotsos**

Dept. of Computer Science and Engineering  
and Centre for Vision Research  
York University, Toronto – Canada

Dr. John Tsotsos is Distinguished Research Professor of Vision Science at York University and holds the Canada Research Chair in Computational Vision. Born in Windsor, Ontario, he holds a doctoral degree from Computer Science from the University of Toronto where he is cross-appointed in Computer Science and in Ophthalmology and Vision Sciences. He is also Adjunct Scientist at the Toronto Rehab Institute.

Among his many accolades are Fellow, Canadian Institute for Advanced Research (1985–95), the 1997 CITO Innovation Award for Leadership in Product Development, the 2006 Canadian Image Processing and Pattern Recognition Society Award for Research Excellence and Service, the Inaugural President's Research Excellence Award at York University in 2009, several best paper awards, and in 2010 he was elected Fellow, Royal Society of Canada.

He has served on numerous conference committees and on the editorial boards of Image & Vision Computing Journal, Computer Vision and Image Understanding, Computational Intelligence and Artificial Intelligence and Medicine. He was the General Chair for the IEEE International Conference on Computer Vision 1999. With Laurent Itti and Geraint Rees, he edited the encyclopedic volume Neurobiology of Attention for Elsevier Press, 2005. His first research monograph titled A Computational Perspective on Visual Attention, MIT Press, was released in May 2011.

# speakers

## Keynote Talk:

### "A View of Vision as Dynamic Tuning of a General Purpose Processor"

The importance of generality in computer vision systems whose goal is to achieve near-human performance was emphasized early in the field's development. Yet this generality in practice has been elusive. In this presentation, I will detail a proposal made in this direction. Using formal methods from complexity theory, we have shown what an architecture for vision might be that has two main properties:

It can solve a particular class of vision problems very quickly, and, it can be tuned dynamically to adapt its performance to the remaining subclasses of vision problems but at a cost of greater time to process. Further, we have shown that a major contributor in this dynamic tuning process is the set of mechanisms that have come to be known as attention. Attentional processing has a strong formal computational foundation and this will be briefly overviewed. The result is a set of attentional mechanisms organized into three classes: selection, suppression and restriction mechanisms. The Selective Tuning model will be described as an embodiment of these mechanisms with broad predictive power for biological vision and significant experimental support. The top-down and recurrent mechanisms include both goals as well as attention mechanisms not specific to tasks or goals. The combined application of elements from the set of attentional mechanisms provides for a means to tune the general-purpose, but limited in functionality, processing network to enable the full set of visual tasks to be solved.

## speakers



### **Prof. Andrew Mark Williams**

Faculty of Health Science

University of Sydney  
Liverpool John Moores University – Australia

A. Mark Williams is Professor, Head of Discipline Exercise and Sports Science and Associate Dean Research and Innovation at The University of Sydney, Australia. Also, he holds a position as Professor of Motor Behaviour at Liverpool John Moores University, UK.

His research interests focus on expertise and its acquisition across domains. He has published over 100 peer-reviewed journal articles in highly-rated sports science (e.g., Journal of Motor Behavior, Medicine and Science in Sport and Exercise) and psychology journals (e.g., Experimental Psychology, Journal of Experimental Psychology: Applied, Acta Psychologica) and written several books, book chapters and professional articles. He is an Executive Editor for the journal Human Movement Science and Psychology Section Editor for the Journal of Sports Science. He also sits on the Editorial Boards of the Journal of Sport and Exercise Psychology, the Scandinavian Journal of Science and Medicine in Sport and the European Journal of Sport Sciences and has acted as a Guest Editor for special issues of Human Movement Science, the Journal of Motor Behavior, the Journal of Sport and Exercise Psychology and the Journal of Experimental Psychology: Applied. He is a member of the Scientific Committee for the European College of Sports Science and is Secretary-General of the World Commission of Science and Sport. He has also been a Visiting Professor at Florida State University, University of Florida, University of Calgary, University of the Mediterranean, Marseilles and Queensland University of Technology. Over the last 10 years, he has received prestigious Distinguished Scholar Awards from some of the foremost institutions in the field (e.g., International Society of Sport Psychology) and more than £2.5 million in external contracts and grants from research councils (e.g., Economic and Social Research Council), commercial companies (e.g., Nike) and sport associations (e.g., UEFA; FIFA).

# speakers

## **Keynote Talk:**

### **"Anticipation and Decision-Making in Sport: From Conceptual Frameworks to Applied Interventions"**

An overview is presented of contemporary research on anticipation and decision-making in sport and other time-constrained domains. The important perceptual-cognitive skills that facilitate anticipation and decision-making are identified and illustrations provided as to how these skills interact in a dynamic manner during performance. The talk highlights our current understanding of how these skills are acquired and considers the extent to which the underlying processes and mechanisms are influenced by emotions such as anxiety and may be specific to a particular domain and/or role within that domain. Next, recent attempts to facilitate the more rapid acquisition of anticipation and decision-making using simulation training coupled with instruction and feedback on task performance are reviewed. Finally, a summary is provided of how research on elite athletes can help inform cognitive psychologists and behavioural neuroscientists who are interested in capturing and enhancing anticipation and decision-making expertise across various domains.



## module organizers

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## students



**Liliya Avdiyenko** (Stream 3)

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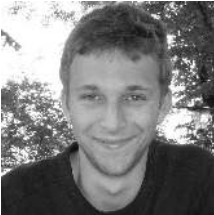
Max Planck Institute for  
Mathematics in the Sciences – Germany

I am a PhD student in the group of Cognition and Neuroscience at the Max Planck Institute for Mathematics in the Sciences, Leipzig. Originally I come from Ukraine. I have Master's degrees in Computer Science from the National Kharkiv University of Radioelectronics (Ukraine) and the University of Wales (UK).

My scientific interests are primary in the field of artificial intelligence, machine learning and their application to computational neuroscience and cognition. Such an interdisciplinary research, on the one hand, gives a possibility to study processes and functions of the brain and nervous system using modelling tools. On the other hand, having inspiration from nature one can use its principles to develop artificial intelligence algorithms able to compete with humans in performance and speed.

The focus of my PhD research is information processing in biological recurrent neural networks for visual perception and pattern recognition. A fact that there is a lot of connections coming back from higher visual areas suggests importance of top-down information flow in visual processing. However, despite an extensive research on human visual system, a role of recurrence is still not well-understood. Task-dependent attention that drives eye movements during a certain task is one of the processes where the recurrent connections could be important. To investigate this question, I developed a neural network for visual classification where the recurrent connections imitate task-dependent attentional instructions to form a sequence of image patches important for the task. Thus, in my work I want to understand whether such instructions modelled using the principles of information theory are crucial for a fast and precise visual classification and whether the developed model can predict human eye-movements during the classification task.

## students



**Ben Niklas Balz** (Stream 4)

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CITEC – Cognitive Interaction Technology  
Universität Bielefeld – Germany

Ben, 21, from Bielefeld

During my school time I spent half a year in South Africa.  
09/10 I did my Civil Service in New Zealand.

Last year I started studying Physics in Bielefeld and got one of CITEC's student scholarships. During this year I visited a lot of totally different talks of the CITEC programme and enjoyed the interdisciplinary approach CITEC is taking.

I'm looking forward to an interesting Summer School!

## students



**Aniko Borbély** (Stream 3)

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Dept. of Gen. and Applied Linguistic  
Debrecen University - Hungary

Previously, I wrote in my CV and Motivation Letter that I graduated in Applied Linguistics at the University of Debrecen. After the University I successfully applied to PhD course.

As I wrote in my Motivation Letter, I work in Computational Linguistic sub-project of the HuComTech (Human-Computer Interaction Technologies) Research Team of Debrecen, Hungary, like an annotator , and PhD student as well.

The sub-project is part of a project conducting research in multimodal human-machine communication. Currently the annotation of the corpus is underway, which is an important part of data processing: labels are placed on the audio material (as well as the transcript) on different levels – those of intonational phrases, emotional/cognitive states, and of discourse. The label groups are classified on the basis of prosody. The questions arising during the annotation process are important from a linguistic point of view as well – marking and differentiating the units of spontaneous speech is not as straightforward as it is in case of written texts, and thus poses problems. The marking of the disfluences typical of spontaneous speech (hesitation, restarting, repetition) as well as structural characteristics (wedged in, embedded, and broken clauses) have required the development of a new system. Consequently, in the Summer School of Bielefeld, I would like to speak about my work ,and I will analyze the disfluences phenomena and these new rules to the occurring phenomena by describing examples from the corpus.

## students



**Marcella de Castro Campos** (Stream 3)

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CITEC – Cognitive Interaction Technology  
Universität Bielefeld – Germany

Graduated in Physical Education by Universidade Federal de Minas Gerais in Brazil (2004) and post graduated in Sports Training by Universidade do Grande Rio also in Brasil (2007). Worked as Sports teacher with at elementary schools and as Sports Trainer in Sports Centers in Brazil. Currently is PhD Student at Center of Excellence Cognitive Interaction Technology (CITEC) at Bielefeld University and researches topics about space representation and orientation, specifically the Influence of response actions on estimating directions and conceptualizing space regions with acoustic stimuli, in the Project "Perceptual Grounding of Spatial Reference Frames in Communication and Action".

Abstract:

"Perceptual Grounding of Spatial Reference Frames in Communication and Action"

Spatial language can give us deep insights into the nature of spatial cognition in general. The concepts of front, back, right, and left regions have characteristics that reflect our typical interactions with space, and the way we conceptualize these regions depends overall on the task we have to do, or on the relation we have to find among them. In the present study we intend to analyze and to relate the verbal responses for recognizing of sound source location (SSL) to 4 different methods from localization and response: (a) no movement and verbal estimate of SSL; (b) turning to face the estimate SSL and verbal estimate; (c) turning to face the estimate SST, pointing with the hand and arm, and verbal estimate and (d) no big movement, touching with a special pen at a special screen, and verbal estimate.

In addition we intend to estimate the relative sizes and resolutions of front, back, left, and right around oneself for each one of these conditions and to make a comparison among them.



# students



## Nienke Berthelijntje Debats (Stream 1)

N.B.Debats@vu.nl

Research Institute MOVE  
Faculty of Human Movement Sciences,  
VU University Amsterdam - The Netherlands

Hello, my name is Nienke Debats. I am 28 years old and for the last ten years I have been living in Amsterdam, where I did my bachelor and master studies at the faculty of human movement sciences (at VU University). I enjoyed my studies so much that I stayed to do a PhD-project, and I am currently in my third year. My PhD-project focuses on a specific type of active haptic perception that is often referred to as 'dynamic touch': the perception of an object's properties by holding it in one hand and moving it around. I studied the perception of rod length, and in particular the relationship between the exploratory movements and the perceptual estimate. In other words, how does 'dynamic' affect 'touch'? Thus far, I have found that rod length perception can be modeled as an instance of cue combination in which the exploratory movements influence the weighting of length cues (published in 2010). This model is based on the hypothesis that exploratory movements influence the precision of individual haptic cues. I am currently testing this hypothesis explicitly.

Besides dynamic touch, I have become interested in the haptic radial-tangential illusion, for which no solid explanation exists to date. This illusion entails that while making whole-arm movements in the horizontal plane, participants overestimate the distance covered in the radial but not in the tangential direction. I have formulated a new hypothesis proposing that the illusion is caused by the change in muscular torque required to counteract gravity while making radial arm movements. A model study on this hypothesis was published in 2010, and we are now concluding the first experimental study.

## students



**Ananda Lima Freire** (Stream 4)

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CoR-Lab – Cognition and Robotics Laboratory  
Bielefeld University – Germany

PhD student in Engineering of Teleinformatic at Federal University of Ceará (Brazil) and adjoint member at Research Institute for Cognition and Robotics (Cor-Lab) in Bielefeld (Germany). Has Master degree in Engineering of Teleinformatic at Federal University of Ceará (2009), during which it was made a case study on the temporal dimension in the design of pattern classifiers for mobile robot navigation. Graduate in Telematic's Technology at Centro Federal de Educação Tecnológica do Ceará (2007). Participation in projects for research and development since 2005. Expertise in the area of Intelligent Robotics and Artificial Neural Networks.

Currently working in a project on hand-eye coordination through neurally inspired learning mechanisms with the humanoid robot iCub. Like humans, who have two different 2D images as visual information, the sense of depth results from logical deduction based on empirical learning, leading to a sensory-motor mapping. With this approach, there is no need for a camera calibration model, nor to do explicit triangulation for calculating the system coordinates of the environment.

## students



**Caspar Mathias Goeke** (Stream 4)

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Department of Neurobiopsychology  
University of Osnabrueck – Germany

Birthday: 31/12/1984

Family-Status: Married

The topics that are most interesting to me are attention during locomotion, EEG-based brain computer interfaces, virtual reality applications and sensory enhancement devices. At the moment I plan to develop new behavioral and neurophysiological methods for an experimental investigation of embodiment and sensory enhancement projects. We designed an fMRI compatible belt that provides allocentric information via tactile stimulation to the body. Subjects train with this device to learn the new regularities of this type of sensorimotor coupling. The project encompasses many different types of measurements that are centered on the question of how the belt information is integrated with our other senses and what are the behavioral and cognitive consequences of this integration process? Mobile electrophysiological and behavioral recording devices allow us to record human behavior, while the participants can freely move and look around.

Therefore, these devices seem to be applications that make it possible to tackle such a question within a real world setting and to observe more natural behavior. In this way I want to record body movements, track overt visual attention and simultaneously record brain activity. With such synchronized recording technique, I assume that many new and interesting questions can be raised.

Bachelor Thesis:

Investigating Neural Processes Underlying Feature-Based Visual Attention – A Combined EEG and Eye-Tracking Study, University of Osnabrück, 2010.

## students



**Mathew Hunter** (Stream 4)

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Jacobs University Bremen – Germany

I am currently a PhD student in the Cognitive Systems and Processes program at Jacobs University in Bremen. I previously attained both my Undergraduate and Masters Behavioural Neuroscience degrees at Laurentian University located in Sudbury, Canada. My previous work has focused on the neurophysiological correlates of stereoscopic viewing in virtual reality paradigms.

My current thesis is centered on the neurophysiological correlates of visual search mechanisms under mesopic viewing environments. An attempt will be made to neurophysiologically characterize visual search deficiencies along a mesopic luminance continuum with appropriate EEG techniques. Concurrently, an attempt will also be made to examine the multi-sensory integration of tactile perception along the continuum towards pure scotopic vision as the availability of visual information is weakened subsequently changing the modality integration prioritization.

This research will ultimately be applied to tactile interfacing of remotely operated rescue robots which are often supplied little to no visual information in dark environments.

## students



**Salvatore Iengo** (Stream 1)

salvatore.iengo@unina.it

Department of Computer Systems Engineering  
University of Naples, Federico II - Italy

Full Name: Salvatore Iengo

Birth date: 08 December 1982

Place of birth: Castellammare di Stabia (NA), Italy

M.Sc thesis title: Human-Robot interaction through gestures.

I have obtained the B.Sc. and M.Sc. degrees in Computer Science both with honours (cum laude) from the University of Naples Federico II. The B.Sc. thesis concerned "Intelligent server monitoring", while the M.Sc. thesis concerned "Human Robot interaction through gestures" (in Italian).

Since January 2011 I am a Ph.D. student in Computer and Automation Engineering at University of Naples Federico II.

My current research interests are oriented towards Human Robot Interaction with biological inspired mechanisms like attention (in the framework of SAPHARI project, Safe and Autonomous Physical Human-Aware Robot Interaction). I enjoy many different topics especially the interplay between neuroscience and computer science. Nevertheless, I am aware I still need further interaction with researchers and research groups in this field to improve my awareness on the topic. I know that this kind of interaction will be present at the CITEC summer school.

I am also interested in dexterous and dual-hand robotic manipulation (mainly in the framework of the EU FP7 DEXMART integrating project).

## students



**Casey Redd Kennington** (Stream 2)

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CITEC – Cognitive Interaction Technology  
Bielefeld University – Germany

Bachelors degree in Computer Science at Brigham Young University. I just completed the Erasmus Mundus European Masters of Language and Communication Technology where I spent my first year at Universität des Saarlandes and my second year at Université de Nancy 2.

My masters thesis title was "Application of Suffix Trees as an Implementation Technique for Varied-Length N-gram Language Models" advised by Professor Martin Kay.

My research interests include language modeling, psycholinguistics, incremental processing, semantics, discourse and dialogue, among others. I will soon begin my PhD studies under Professor Dr. David Schlangen at Bielefeld University in incremental discourse and dialogue.

## students



**Alexandre Lang** (Stream 4)

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University of Technology of Compiègne – France

Since October 2007, I am a PhD student at the Cognitive Research and Enactive Design Group (CRED-COSTECH) at the University of Technology of Compiègne, France. I'm currently ending my dissertation and the viva is planned for November. The provisional title of my thesis is "'Implicit' learning of a continuous motor skill based on visual regularities".

Actually, my doctoral research focused on the role played by attentional mechanisms during the so-called "implicit" learning of fine motor skills. More specifically, I investigated the way a performer makes use of some regularities that were experimentally introduced in the material in a manual pursuit-tracking task.

In my view, implicit learning does not refer to learning without attention but rather to a mode of acquisition occurring without intention to learn and to profit from the acquired knowledge. My background is both in cognitive psychology (PhD), cognitive sciences (Master degree) and engineering (M.Sc. degree).

## students



**Hagen Lehmann** (Stream 3)

hagen.lehmann@gmail.com

Adaptive Systems Research Group  
University of Hertfordshire – UK

I did my first degree in Psychology at the Technical University Dresden. After finishing my studies in Dresden I worked as research assistant at the Max-Planck Institute for Evolutionary Anthropology in Leipzig. I worked with different primate species, e.g. Chimpanzees, Bonobos and Gorillas, and human infants. The topic of my research was gaze behaviour and its role in human social evolution. In 2005 I started my PhD at the University of Bath. I worked in the Department of Computer Science on the applicability of Agent Based Modelling in behavioural ecology. During my PhD thesis, I worked in different interdisciplinary research fields examining possible reasons for the evolution of social structure in non-human primates and the role of social dominance in this process. I tested the applicability of agent-based modelling as relatively new technique into social science. One of my projects was the development of an agent-based model that simulates the influence of matrilineal dominance inheritance on the evolution of social structure in different primate species.

Since last year July I work as a post doc in the Adaptive Systems Research Group at the University of Hertfordshire in the field of social robotics. At the moment I am involved in the iTalk and the AURORA project. Within the AURORA project I work with the KASPAR robot, the IROMEC robotic platform and autistic children. The aim of this project is the development of a therapeutic robot to help children with autism to enhance their social skills. In this project I am working mainly on the improvement of human-robot interaction.

The aim of the iTalk project is to enable the iCUB robot to learn language in a child like way through the interaction with humans. I am involved in most of the research aspects of this project. My main fields of interest are the evolution of social behaviour and language, social cognition, artificial intelligence, robotics and human-robot interaction.



# students



**Johannes Lohmann** (Stream 1)

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Department of Psychology III  
University of Würzburg - Germany

I graduated in Psychology in 2010 at the university of Würzburg. In my diploma thesis I proposed an extension of the well established Theory of Visual Attention (TVA) that added a dynamic working memory model to the TVA framework. The aim was to account for both attentional and memory processes at once. The benchmark test for this combined model was data regarding change detection that was obtained from the literature as well as from experiments conducted at the university of Würzburg.

Right after this I started my PhD at the COBOSLAB research group headed by Martin V. Butz, who now holds the chair for cognitive modeling at the university of Tübingen. The basic idea of my thesis, with the working title „Integration of Vision and Proprioception: The Acquisition of a multi-modal Body Schema“, is to combine proprioception and vision into a common representation that allows bidirectional predictions from one modality to the other. This might be a first step to a multi-modal body scheme. Attention plays a crucial part in this architecture as only task-relevant information should be integrated. The whole approach relies on unsupervised learning of correlations between proprioception and vision via Hebbian learning.

So far the architecture is very basic. Proprioception in terms of a joint-space is realized as a population code. The visual information processing is accomplished in a cortex-like architecture that was proposed by Serre et al. In the near future visual attention will be implemented within a Bayesian network that allows to discriminate between location and feature based attention. Additionally, it is planned to replace the current Hebbian learning with a restricted Boltzman machine that should provide deeper insights into the representations underlying the predictions.

# students



**Diako Mardanbegi** (Stream 2)

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Denmark

## My background:

During my master study in the field of biomechanical engineering, I became very interested in eye movement behavior, thus I tried to develop an eye tracker (Dias eye tracker) as my project. My main wish was to make a software that enables the user to interact with computer using the eye and also with the ability of exporting and plotting the eye movements data for further analysis. After finishing my master's project, I was very keen to continue my research in this field especially in mobile eye tracking.

## My current project:

Title: Gaze-Based Environment Control

Today, gaze interaction is done through remote eye trackers and mostly used for help and assistance the disabled peoples sitting in front of a single screen. In the other hand HMGT systems are mounted on the user to allow for a higher degree of mobility. The main goal of my PhD project is do research in algorithms for head mounted eye tracking and to investigate how head mounted eye trackers can be used for interaction with the environment. I would like to generalize the concept of gaze interaction and investigate the possibility of using a gaze tracker for interaction with computers and also with other environment objects for example in an intelligent house. Eye movement data and gaze patterns that are provided by the eye tracker can also be used for studying the human cognition and behavior during doing the different tasks and interaction.

# students



## Santiago Martinez (Stream 2)

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University of Abertay-Dundee – UK

### 1) Introducing myself

I am Santiago Martinez. I am 32 years old and I'm Spanish. I lived in Spain until 2009, when I moved to Scotland (Dundee) to start an interdisciplinary PhD. My background is Computer Science. I studied in Seville (Spain) for a 6-year double-Engineering degree and later I finished an MPhil in Malaga (Spain) on Software Engineering and Artificial Intelligence. After that, I received an offer from the University of Abertay Dundee and I started a PhD in Human-Computer Interaction.

### 2) Research trigger: Working in the private sector

Before I finished my first studies in Seville, I worked in an IT consulting company in the private sector. I was developing an official document system in a hospital and, closely working with end users, made me realize that software applications could be better built, and overall, the technology could be designed working for and with users. Soon I became aware that the company I was working was in a deadlock process of building orthodox applications, instead of creating dynamic solutions for real users. I started switching my interests towards the end-user: user-centred design, error management and training end-users. It was then when I realized that first-time or technologically naive users were not supported, and not very well assisted in their daily interactions with technology.

### 3) My Research

My general aims on Research are on IT design, thinking on people, users, before than in products. I apply usability paradigms in social contexts. There has been a gradual shift within the area of HCI to include qualitative methodology studies in users' natural environment. Several aspects, from low-level interaction on controlled laboratory experiments to an emphasis on environmental context, could shape the bases of new approaches to this topic.

The title of my Thesis is Enhancing real-world user interfaces using audio-visual and gestural control metaphors. My research is focused on how humans interact with technology for first time.

## students



**Andrei Melnik** (Stream 1)

andrei.melnik@uni-osnabrueck.de

Institute of Cognitive Science  
University of Osnabrueck – Germany

2004–2010:

Bachelor & Master at the Institute for Higher Nervous Activity and Neurophysiology at the Moscow Institute of Physics and Technologies. Bachelor thesis: Source Analysis of P300 Component of Visual Event-Related Potentials in Paradigm "Brain-Computer" Interface. Master thesis: EEG Differences Between "Living" and "Nonliving" Objects in Visual Categorization Task in Humans.

2010–present:

PhD at the Institute of Cognitive Science at the University of Osnabrück, Germany.

PhD thesis: Integration of Multisensory Information in the Human Brain and in Artificial Neuronal Networks

Current PhD project:

One of the major challenges in the field of Cognitive Science is to develop technologies that can recognize and process complex patterns occurring in natural environments, for example recognizing objects, faces, speech and scenes, learning how to move in natural environments, understanding the context of a situation and what is happening in it etc. These are things that humans can do, but machines cannot. There are currently many attempts to build specialized systems such as object recognition systems, face recognition systems, speech recognition systems etc. Many of these attempts, however, are bound to fail. The reason for this is that the human brain consists of a bunch of highly specialized systems that evaluate and process sensory information. These systems are highly interconnected and support each other. They can only perform the functions mentioned above as a unified system. In other words, one of the basic features of human brain design that makes it so unique is that a bunch of unreliable, highly specialized components are combined into a reliable, more general system. The integration of multisensory information and interactions between brain regions is a basis for this principle and therefore a prerequisite for further technological advances. However, many of the current research projects looking into the development of specialized systems do not take the importance of integration into account. My PhD project aims to address this problem by looking inside the brain (EEG experiments) – the mechanism that is already able to recognize and process complex patterns – and to try to copy the way it functions (hierarchical neuronal network experiments).

## students



**Nicole Mirnig** (Stream 2)

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ICT&S Center –  
Information and Communication Technologies & Society  
University of Salzburg – Austria

I am a first year PhD student at the HCI Unit of the ICT&S Center at the University of Salzburg. During my master's studies in communication, I already focused my research on the communication between humans and robots. I performed an observation study on itinerary requests in public space to detect those element that make the communication between humans work so effectively. Based on the results and on the Shannon and Waever model of communication, I developed a communication structure to inform human-robot interaction (HRI) in a similar situation and context. The communication structure was in part verified by means of a follow-up Wizard-of-Oz experiment with a robot that was interacting with participants in a lab setting.

Continuing my work in HRI, I am involved in the EU-project IURO ([www.iuro-project.eu](http://www.iuro-project.eu)) that aims at developing interaction paradigms for an interactive urban robot. In my PhD thesis (Working title „Feedback Modalities and Strategies in HRI“) I pursue my work on improving the interaction between humans and robots in social dialog situations. In particular, I research different feedback modalities and try to build strategies that support successful human-robot communication (HRC). I am very much interested in how a robot can best possibly display its internal state and intentions to a human interaction partner and in doing so to support successful HRI.

It is not my aim to copy the human organism and build a perfect robot. Instead I want to find out what makes us humans communicate so flexibly and be that adaptable. I would like to use some of these mechanisms and features to inform and improve HRC.

## students



**Redwan Abdo Abdullah Mohammed** (Stream 4)

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Department of Computer Science and Electrical Engineering  
Rostock University – Germany

### Curriculum Vitae

M. Sc Redwan Abdo A. Mohammed

I received my B.Sc degree in Computer Science in June 2005 from Faculty of Science, Sana'a University, Yemen and my M.Sc degree in Computational Engineering from Rostock University, Germany in February 2011.

Since June 2011, I am PhD. student in the Faculty of Computer Science and Electrical Engineering, Rostock University, Germany.

### Research Fields

- Visual Computing and Machine Learning
- Human Computer Interaction
- Artificial Intelligence

### Current Research Projects

- Analysis of Natural Luminance and Depth Images
- 3-Dimensional Surface Recognition
- Models for Bottom up Visual Attention
- Cognitive Modells for Intention Recognition

# students



**José Pablo Ossandón** (Stream 4)

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Institute of Cognitive Science  
Osnabrück University – Germany

I studied medicine and did a master in neuroscience in Chile and then move to Osnabrück where I am currently pursuing a PhD on Cognitive Science. The main research topic I am involved in Osnabrück is about the guidance of visual overt attention in humans. In brief, the current development of visual selection models distinguishes between bottom-up and top-down mechanism of control. However it is not clear how these mechanisms of visual attention interact under natural viewing conditions. Particularly, is it not clear whether there is any role for a pure bottom-up system of attention guidance in natural viewing and how it is implemented in the brain.

In my PhD research, I have followed three lines of research that can give new insights about this problem. The first research project objective is to describe the influence of stimulus driven control on visual selection when putative top-down cortical areas are impaired as in the case of patients with neglect syndrome. The second research project objective is to understand pure spatial bias when people free explore natural scene images. Finally, in the last project, a more direct study of the brain dynamics of visual selection is attempted by studying the electroencephalographic correlates of bottom- up and top-down control of overt attention.

## students



**Matia Pizzoli** (Stream 4)

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Dipartimento di Informatica e Sistemistica  
Sapienza Università di Roma- Italy

I received my bachelor degree from University of Rome "Sapienza", with a thesis titled "computational non robustness in geometric algorithms", supervised by prof. Fabrizio D'Amore. The work was a study on robustness issues raising from the use of computer arithmetics to solve geometric problems. As case study, a state of the art computational algorithm to solve Delaunay Triangulation was implemented and numerical robustness was investigated.

On September 2007 I received my master degree (cum laude) from University of Rome "Sapienza", with a dissertation on automatic face recognition from images. Together with a comprehensive overview and comparison on computer vision techniques to address the face recognition problem, an algorithm relying on stereo vision was proposed and analysed. The resulting system was demonstrated at "Città e Sicurezza" Workshop, on March 31st 2007. From November 2007 I own a scholarship for a PhD program in computer engineering, supervised by prof. Fiara Pirri. I work at ALCOR cognitive robotics lab (<http://www.dis.uniroma1.it/~alcor>). My research is focused on computer vision and pattern recognition.

On November 2007 I attended SC2007 PhD school on Soft Computing and its applications. On July 2008 and July 2009 I attended the International Computer Vision Summer School (ICVSS) on Machine Learning for Computer Vision and Reconstruction and Recognition.

From December 2009 I'm developing a framework for the study of human attention and Human Robot Interaction in the context of the EU funded project NIFTI ([www.nifti.eu](http://www.nifti.eu)), aiming at providing natural cooperation between humans and teams of robots in Urban Search and Rescue scenarios.



# students



**Laura Pomarjanschki** (Stream 3)

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University of Lübeck – Germany

Thesis working title: Learning to see better

Research abstract:

Although we are under the impression of a perfect, continuous representation of the surrounding world, only the visual information that is projected on a small part of the retina – the fovea – is transmitted in great detail to the brain. The eyes move constantly to align onto the fovea different regions of interest and attentional mechanisms select the relevant information from the scene.

Gaze guidance can be used to improve the way we scan our environment. Reading a text, interpreting a radiograph, driving a car, all involve following certain gaze patterns, which evolve during the process of learning the task. In this project, we use gaze-contingent interactive displays to present the information in such a manner as to guide eye movements to desired locations, and by doing so, guide observers towards using a more efficient viewing pattern.

Our current experiments were designed to alter eye movements and driving behaviour in safety critical situations. These experiments showed that in a simulated environment, drivers tend to make less accidents when high-risk pedestrians are highlighted using gaze-contingent cues.

Date of birth: 20.03.1984

Place of birth: Bucharest, Romania

Education:

October 2008 – present: PhD student at the Institute for Neuro- and Bioinformatics, within the Graduate School for Computing in Medicine and Life Sciences, University of Lübeck

October 2003 – July 2008: Student of Computer Science and Telecommunications, University "Politehnica" of Bucharest, Romania

## students



**Nicolas Riche** (Stream 3)

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TCTS Lab – Théorie des Circuits et Traitement du Signal  
Engineering Faculty, University of Mons – Belgium

Nicolas Riche holds an Electrical Engineering degree from the University of Mons, Engineering Faculty (since June 2010). His master thesis was performed at the University of Montreal (UdM) and dealt with automatic analysis of the articulatory parameters for the production of piano timbre. He obtained a FRIA (Belgian research funding agency – FNRS) grant for pursuing a PhD thesis about the implementation of a multimodal model of attention for real time applications.

In his PhD thesis, he proposes to generate a multimodal model able to work with any type of signals:

- Spatial (static images)
- Temporal (audio, gestures)
- Spatiotemporal (videos)

The first step was to study the visual and audio features. With the release of the Kinect sensor (Microsoft), in November 2010, 3D features have become easily accessible. In terms of computational attention this depth information is very important. Indeed, in all models released up to now, movement perpendicular to the plane of the camera could not be taken into account. A 3D model-based motion detection in a scene has been implemented. The proposed method is based on 3D features (speed and direction) extraction and their rarity quantification to compute bottom-up saliency maps. The final purpose is to make the model as generic as possible to be useful for many applications by adapting to the relevant characteristics. The model would deal with the number and type of the acquired features as well in space as in time on several scales. This model has the hard constraint to work in real time. This implies to search about the best compromise between efficiency and computational load.

## students



**Boris Schauerte** (Stream 2)

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Karlsruhe Institute of Technology – Germany

I am a third year PhD student at the Karlsruhe Institute of Technology and member of the collaborative research center “Humanoide Roboter” and the international center for advanced communication technologies.

My Research: Multimodal Attention for Technical Systems.

Identifying verbally and non-verbally referred-to objects is an important aspect of everyday human-human and, consequently, human-robot interaction. It is essential to coordinate the attention with interaction partners and achieve joint attention. I created a computational attention model that integrates spatial information provided by pointing gestures as well as linguistic descriptions about the visual appearance of the target. This way, we are able to determine known and previously unknown referred-to objects.

Attention allows robots to focus their limited computational resources while controlling the sensor orientation to improve the perception. Thus, it is essential to operate in complex environments. We created an integrated system for audio-visual scene exploration and analysis. To this end, I developed, e.g., surprise-based auditory saliency, isophote-based saliency map segmentation, and a parametric 3-D audio-visual saliency fusion with object-based inhibition of return. Smart environments have to process a huge amount of multimodal sensor information in real-time. Thus, attention mechanisms are advisable. I proposed a voxel-based 3-D audio-visual attention system. For overt attention, the cameras are controlled actively to optimize the model quality, i.e. reconstruction error (their placement is optimized offline). For covert attention, based on the 3-D saliency, optimization is used to estimate the best view(s) of the scene for algorithms and/or human observers.

## students



**Alexandra Staudt** (Stream 2)

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Debrecen University – Hungary

I graduated from the Faculty of Humanities, University of Debrecen, Hungary, majoring in Theoretical Linguistics and History. Completing the university in 2010, I started working at the Department of General and Applied Linguistics in an EU-funded multidisciplinary project as an annotator. I worked on the processing of a Hungarian multimodal corpus which was built by the Hungarian HuComTech (Human-Computer Technologies) research team. I examined some phenomena of Hungarian spontaneous speech (for instance, restarts, disfluencies, hesitations etc.) and their features. Meanwhile I learnt a lot about Hungarian spontaneous speech, and finally, I decided to apply for a PhD programme in Linguistics.

At the moment I am a first-year PhD student of Computational Linguistics at the University of Debrecen. The title of my research topic is the following: Analysis of restarts for the improvement of automatic speech recognition. I am going to research the suprasegmental parameters of disfluency phenomena in order to be able to expand our knowledge about spontaneous speech. Also, it will be useful for the development of the automatic spontaneous speech segmentation system. In my study I examined the types of restarts and the strategies applied in order to notice perceptually nothing by the listener. I would like to find out if there is a difference in the number of restarts in the different situations (formal vs. informal).

# students



**Claudius Strub** (Stream 3)

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CITEC – Cognitive Interaction Technology  
Bielefeld University – Germany

Claudius Strub, born in 1987, Potsdam, Germany.  
I got my "Abitur" in 2006 and started to study "Kognitive Informatik" in Bielefeld in 2007, after accomplishing my military service.

The title of my bachelor thesis was "GPU based warping for visual homing", where I implemented an image warping algorithm on a GPU by using OpenGL shaders. The algorithm uses two omnidirectional (panorama) camera images to compute the translation and rotation between the locations of these two images. This only works, if the images were taken at two distinct but sufficiently close locations. The application scenario was to run it on a GPU of a mobile robot in order estimate egomotion and use it for visual navigation. Although ending up with a very flexible implementation with respect to the paramertisation, the desired performance could not be met.

So far i have mainly accomplished courses in the fields of robotics, machine learning, artificial intelligence and computer vision. Furthermore i am interested in neurobiology and neuropsychology. I worked as a student assistant in the neurobiology group and at the computer engineering group for two and a half years.

My future work in the master-programme "Intelligente Systeme" will concentrate on artificial neural networks, with the focus on applications in the field of robotics.

## students



**Garrett Scot Preston Swan** (Stream 4)

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Syracuse University – USA

My name is Garrett Swan, and I am a first year Ph.D. student in the Cognition, Brain, and Behavior program at Syracuse University. I received my undergraduate degree from North Carolina State University in Psychology this past May.

In my first semester, I will be running a behavioral test to determine the structural validity of a computational visual attention model called the ST<sup>3</sup> model, proposed by my P.I. Brad Wyble Ph.D.. In the experiment I am running this fall, I am testing for the presence of localized attention inhibition (LAI) by altering spatial separation between two rapid–serial visual presentation (RSVP) streams. Fifty participants will observe RSVP streams and attempt to identify T<sub>1</sub> and T<sub>2</sub> (target stimuli) against distracter stimuli. RSVP streams will vary in spatial separations at 1, 3, and 7 degrees along a circular perimeter, and subjects will not be told which stream the T<sub>1</sub> and T<sub>2</sub> will occur. The second portion of this experiment involves repeating the same procedure, but informing the participants where T<sub>1</sub> will appear to eliminate the subjects' uncertainty.

The goal of this experiment is to investigate putative spatial inhibitory surround effects elicited by a target in an RSVP stream. Typically, participants have trouble reporting T<sub>2</sub>, a phenomenon known as the attentional blink. We predict that decreased spatial separation will result in surround inhibition if T<sub>2</sub> is directly after T<sub>1</sub> whether the location of the T<sub>1</sub> is known or not.

## students



**Istvan Szekrényes** (Stream 2)

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Debrecen University – Hungary

I started my studies as a Philosophy major at the University of Debrecen in 2002. I had a very wide field of interest, I dealt with both continental and analytic paradigms in my first years. Later, I started to concentrate on language philosophy and logical semantics, and applied for Theoretical Linguistics major at the General and Applied Linguistics Department (2005) where I managed to find a sufficiently hybrid field by which my versatile interest was fully satisfied.

The title of my thesis was Attempts to interpret forward-looking statements but I was also interested in applied fields like experimental phonetics and logical programming. Information technology was one of my hobbies, and when our project (Hungarian Human Computer Interaction Technology) was started, I could use my skills and experiments to make the processing of the HuComTech corpus faster and easier. During my work, I have gained a lot of experience in automatic processing methods as well (mainly in the scripting language of Praat Speech processing program).

Related to my PhD research, I want to use this technical as well as theoretical knowledge to investigate the dynamic structure of human – human interactions and how is it performed by the participants. My long-term aims are the detection and prediction of the main points of this structure, for instance, the forthcoming end of a turn in a dialogue. I mostly have a prosodic background but I also wish to deal with multimodality.

## students



**Leslie Michael Theunissen** (Stream 1)

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CITEC – Cognitive Interaction Technology  
Bielefeld University – Germany

In 2010 I started my PhD Project, ViTaPro: Visual, tactile and proprioceptive cues for spatial coordination of the legs in insect locomotion (<http://www.cit-ec.de/GraduateSchool/Projects/ViTaPro>).

I did my Bachelor of Science in Biology and Chemistry in Münster and got in contact with insect locomotion in the scientific oriented Master's Program "Systems Biology of Brain and Behaviour" at Bielefeld University. Insects use different sensory modalities to orientate in complex environments. The stick insect *Carausius morosus* is wingless and compared to flies it has a poor visual system, but, nevertheless, it is capable of spatial coordination of six legs without falling off the canopy. Although it is known, that stick insects use antennal touch information and proprioceptive cues for spatial leg coordination, their roles for climbing are little understood.

In particular, I am interested in the integration of multi-modal information during locomotion. For that reason, I reconstruct and analyse the unrestrained movements of climbing stick insects with the help of a Vicon motion capture system (Vicon, Oxford, UK) and MatLab (The MathWorks, MA, USA). Different setups, e.g. steps of different height with and without visual cues and gaps of different width, are used to find out about the relative importance of vision, touch and proprioception in leg coordination.





# notes

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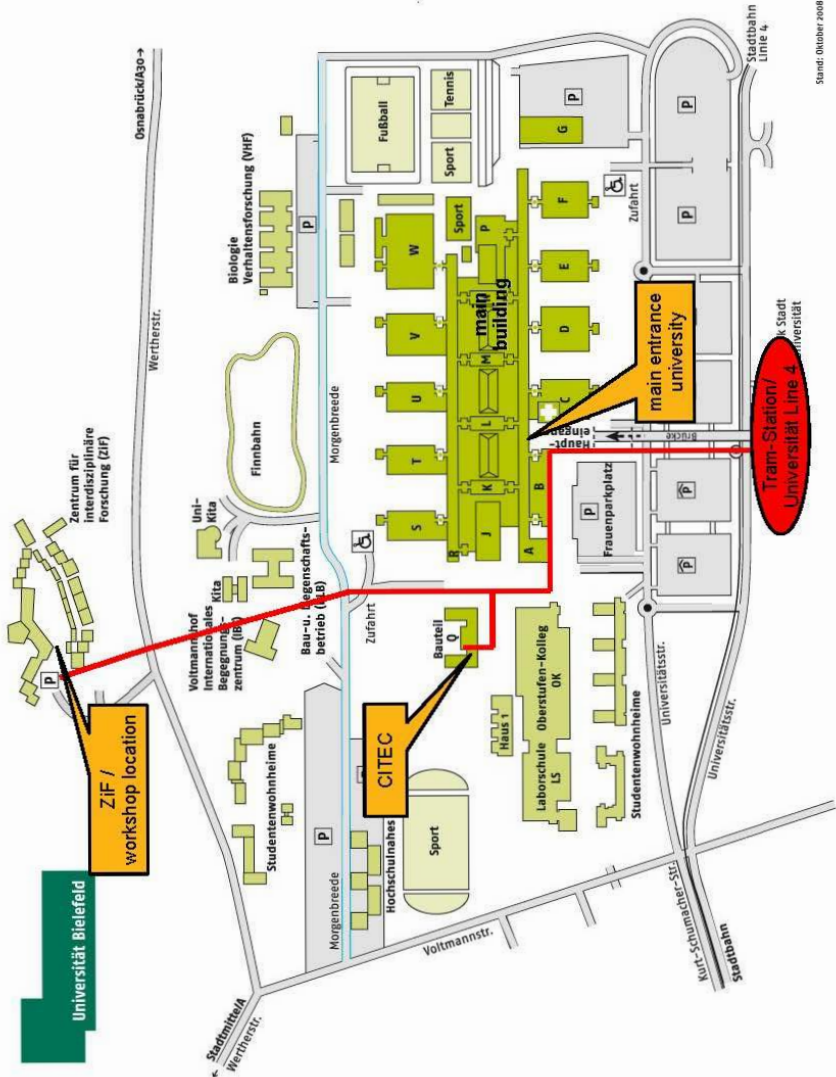
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# map



Sand: Oktober 2008