Visual Computing

RESEARCH AND INNOVATION CENTER

international
summerschool
on visual computing

AUGUST 17–21, 2015
IN ROSTOCK, GERMANY

Fraunhofer IGD

Universität Rostock
Traditio et Innovatio

PREFACE



The International SUMMER SCHOOL on Visual Computing is a workshop for young researchers in the fields of Perception, Image and Multimedia Databases, Computer Vision, Human-Computer Interaction, Visualization, and Visual Analytics. It is jointly organized by the Fraunhofer Institute for Computer Graphics Research Rostock and the University of Rostock. The week-long SUMMER SCHOOL brings distinguished speakers from the US, UK, Austria, and Germany to Rostock for tutorials and research talks.

Aside listening in to these talks, participating young researchers have the opportunity to present their own research in posters and short presentations, and to publish it as part of the SUMMER SCHOOL proceedings. A panel discussion on the traps and pitfalls of conducting PhD-level research and writing a PhD thesis, as well as a demo tour and open lab event to look behind the scenes of the Fraunhofer IGD research round off the week.

The SUMMER SCHOOL has been made possible through the generous support by the state of Mecklenburg-Vorpommern and EFRE within the project "Basic and Applied Research in Interactive Document Engineering and Maritime Graphics". Furthermore, numerous organizational and industrial supporters have contributed to make the SUMMER SCHOOL a successful event. Their support is gratefully acknowledged!

We wish everyone – invited speakers, participants, supporters, and guests – a week full of fruitful discussions, thought-provoking talks, fascinating demos, and interesting coffee break conversations. Simply put: we wish everyone the particular kind of fun that researchers have when they get together over novel methods scribbled on napkins and new ideas sketched along the margins of this booklet.

Prof. Dr. Bodo Urban

Prof. Dr. Uwe Freiherr von Lukas

Dr. Hans-Jörg Schulz

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WIRELESS INTERNET ACCESS

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VENUE OF SUMMER SCHOOL 2015

WELCOME TO ROSTOCK

Rostock is the largest city in the north German state Mecklenburg-Vorpommern. The city of Rostock is located at the river Warnow; the district of Warnemünde (which translates to mouth of the river Warnow) is located 12 kilometers north of the city center, directly at the coast of the Baltic Sea.
Even though, Rostock was granted city rights in 1218, the actual rise of the city began a bit later with the membership of the Hanseatic League, beginning in 1251. In the 14th century, Rostock was a powerful seaport town with 12,000 inhabitants and the biggest city of Mecklenburg. Ships for cruising the Baltic Sea were constructed in Rostock. In 1323 the formerly independent fishing village of Warnemünde became a part of Rostock, to secure the city's access to the Baltic Sea. Furthermore, Rostock is home to the oldest university of the Baltic area and one of the oldest universities in the world, the University of Rostock, founded in 1419.

SUMMER SCHOOL LOCATION

Fraunhofer Institute for Computer Graphics Research IGD
Joachim-Jungius-Strasse 11
18059 Rostock, Germany

The Rostock location of the Fraunhofer IGD can look back on almost 20 years of research work. Since its founding in January 1992, Rostock has consistently built on its already well-established expertise in Visual Computing, which covers the areas of multimedia communication, systematic handling of knowledge, mobile multimedia applications, and entertainment. It also provides solutions and applications that aid the interaction between humans and computers. In order to further improve its position on the research market in the future, researchers in Rostock are focusing on more specialized topics and on the key industries in the state of Mecklenburg-Vorpommern. These include maritime business, information technology, software development as well as agriculture, and tourism.

The „Visual Computing Research and Innovation Center" (VCRIC), also located at the premises of Fraunhofer IGD in Rostock is a joint facility of the Fraunhofer-Gesellschaft and the University of Rostock. In a close cooperation, preliminary fundamental research and on top of that, Fraunhofer-typical applied research and development is done.

ORGANIZERS

ROSTOCK ORGANIZING COMMITTEE

Dipl.-Inf. Mario Aehnelt

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John Trimpop, M.Sc.

Dr. Steffen Hadlak

Dipl.-Inf. Stephan Ohl

Dipl.-Inf. Matthias Vahl

TUTORIAL: 8:30 – 12:00

Bernice Rogowitz, PhD
(Visual Perspectives Research and Consulting, USA)
Cognition & Visual Perception

ABSTRACT

Visualization, imaging and computer graphics provide visual representations of data in order to communicate, provide insight and enhance problem solving. The human observer actively processes and interacts with these visual representations using perceptual and cognitive mechanisms that have evolved over millions of years. The goal of this course is to provide an introduction to these processing mechanisms, and to show how this knowledge can guide the decisions we make about how visually represent patterns and relationships in data. To do so, we will explore important theoretical and experimental results from the fields of experimental psychology, physiology and neurosciences. We will see how these results can be applied to visualization and imaging problems, using real-world examples from many domains, including medicine, physics and finance.

This lecture is designed to:

- help you understand basic principles of spatial, temporal, and color processing by the human visual system,
- introduce you to basic cognitive processes, including visual attention and semantics, and
- provide you with skills in applying this knowledge to applications involving visualization, visual analytics, imaging and computer graphics.

RESEARCH TALK: 13:00 – 13:45

Dr. Michael Burch
(VISUS Visualization Research Center Stuttgart, Germany)

Advances in Eyetracking

ABSTRACT

Tracking people's eye movements can be useful to find out when and where visual attention is paid to a displayed stimulus. This can be important in various application fields like marketing, psychology, human-computer interaction, or information visualization. In particular, understanding visual task solution strategies can help to detect design flaws in visualization techniques and to improve them with the goal to make them more efficiently usable. The challenging issue with eyetracking techniques is not that they are not affordable as some years ago but more that they generate spatio-temporal data which needs sophisticated analysis and visualization techniques. The goal is to explore the data for common rules among a group of eyetracked people or for anomalies and outliers. Eyetracking is more and more moving from the laboratory to the real-world making the recorded data to big data by also incorporating additional data sources such as pupil dilations, electroencephalography (EEG), galvanic skin response (GSR), motion tracking, functional magnetic resonance imaging (fMRI), verbal data, mouse and keyboard interactions, or personal data from social networks. In this talk I will explain the advances in eyetracking by looking at the past, the present, and the future of this relatively novel field in visualization research taking into account several relevant categories and applications.

STUDENT TALK: 13:45 – 14:15

Nina Flad
(Max Planck Institute of Biological Cybernetics, Tübingen, Germany)

Towards Studying the Influence of Information Channel Properties on Visual Scanning Processes

ABSTRACT

Humans move their eyes to gather task-relevant information about their environment. For example, a driver has to monitor self-velocity, proximity to nearby cars, and the speed limit by shifting his gaze between the dashboard, road and street signs periodically. In this regard, each region-of-interest (ROI) represents an information channel that can be defined in terms of their frequency of updating, or their perceived value.

ROI characteristics are known to directly influence observable visual scanning behavior (e.g., Senders, 1980). ROIs that change more frequently or exhibit a higher probability of reaching a critical value tend to be fixated more often. By assuming each fixation as a unit measure of information update, it is possible to derive models that estimate the relative importance of each ROI and their associated properties. However, it is remains unclear whether fixated information is necessarily processed. If it is, it might be worthwhile to determine the specific processes that are involved as well as the extent to which fixated information is processed. The primary aim of my research is to study how ROI properties (e.g., updating frequencies, relevance for a main task or couplings between channels) might directly influence the neuro-cognitive processes (i.e., visual attention, task-switching) that underlie scanning behavior.

Information processing can be investigated by means of electroencephalographic (EEG) recordings and event-related potentials. Unfortunately, studies that employ these techniques are typically designed to avoid eye-movements, which introduce artifacts in the data and occlude the cortical signals. When studying information seeking and processing behavior, we cannot restrict our studies to be free of eye-movements. Hence, we need a way to remove these artifacts without affecting the underlying brain activity.

So far, I have been dealing with the technical challenges arising from recording EEG in a visual scanning task. On the one hand, I synchronized eye-movements and EEG via EOG data. This allows me to analyze the cortical activity with regards to fixation onsets. On the other hand, I removed eye-induced artifacts from EEG data via independent component analysis. In the corrected data, I could find the same task-related components as are found in comparable studies without eye-movements. This means that the artifacts can be removed without affecting the cortical signals of interest. My methods constitute a first step towards studying the influence of information channel properties on information processing. In subsequent work, I will employ these and similar procedures to study information seeking and processing behavior in controlled experimental tasks as well as in complex environments, namely driving simulators.

Reference

Senders, John W.: Visual scanning processes. Drukkerij Neo Print, 1980.

STUDENT TALK: 14:15 – 14:45

Kathrin Ballweg
(Technische Universität Darmstadt, Germany)

A Survey of Perception and Cognition Aspects Influencing Network Visualization and Visual Network Comparison

ABSTRACT

The comparison of networks (i.e., graphs consisting of nodes connected by edges) is often needed in many application areas, for instance biology (the comparison of phylogenetic trees), or finance (the assessment of contagion in financial networks) [1, 2]. The network comparison is often supported by interactive visualizations [3]. By now various visual comparison techniques have been developed for specific applications [4]. Open questions are concerned with the design of node-link diagrams so that commonalities and differences can be spotted easily and with helpful interaction techniques. These techniques need to follow general guidelines obeying human perception and cognition capabilities.

The literature that is formative for this research topic can be divided into four research areas: network visualization, visual network comparison, perception of network visualization and cognitive processes in network comparison. Several recent reviews summarize the techniques proposed in the area of network visualization and visual network comparison [4, 5, 6, 7, 8, 9, 10]. However, an encompassing overview of the state of the art in the perception of network visualization and visual network comparison is missing.
Based on a thorough review of literature, we identify several influence factors for the perception and interpretation of network visualization. We review the main aspects of cognitive processes in network comparison. We consider these two steps to be the start for structuring this broad, two fields combining (psychology and network visualization) area. Furthermore our overview also shows gaps in the research coverage and thus states future challenges in analyzing perception and cognitive processes in visual network comparison.

References

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STUDENT TALK: 15:15 – 15:45

Soumya Paul
(Max Planck Institute of Biological Cybernetics, Tübingen, Germany)
Analysis on Body Perception and Distortion using Mixed Reality Environment

ABSTRACT

So far in my research studies with mixed reality, I have focused on using body and hand motion tracking systems in order to animate different 3D self-avatars in immersive virtual reality environments (head-mounted displays or desktop virtual reality). We are using self-avatars to explore the following basic research question:

What sensory information is used to perceive one's body dimensions? And the applied question of how we can best create a calibrated self-avatar for efficient use in first-person immersive head-mounted display interaction scenarios. The self-avatar used for such research questions and applications has to be precise, easy to use and enable the virtual hand and body to interact with physical objects. And also we are trying to build augmented reality framework through which we can access the animated self-avatar in real scenes. This is what my research has focused on thus far and what I am developing for the completion of first year of my research. We are using LEAP motion for hand and arm movements and the Moven Inertial Measurement suit for full body tracking and the Oculus DK2 head-mounted display. We are planning to use Human Interface Laboratory open source augmented reality framework to access the virtual scene in a real world scenario. We want to build a mixed reality frame work where as an AR object users can see and use their Self Avatar in a real platform and as a VR object user can represent themselves in an immersive virtual reality environment.

STUDENT TALK: 15:45 – 16:15

Marian Haescher
(Fraunhofer IGD Rostock, University of Rostock, Germany)
Detecting Anomalies in Vital- And Activity-Data during Low-Amplitude Activities

ABSTRACT

Currently pathologic health states can only be detected while having a direct consultation with a physician. Medical devices such as ECG devices that are fixed to a certain location are used for this purposes. As a result of this symptoms, which occur in timeframes outside the consultation window can only be tracked by a classic anamnesis. This results in the loss of valuable data and a subjective report that is biased by the patient's own perception of the symptoms.

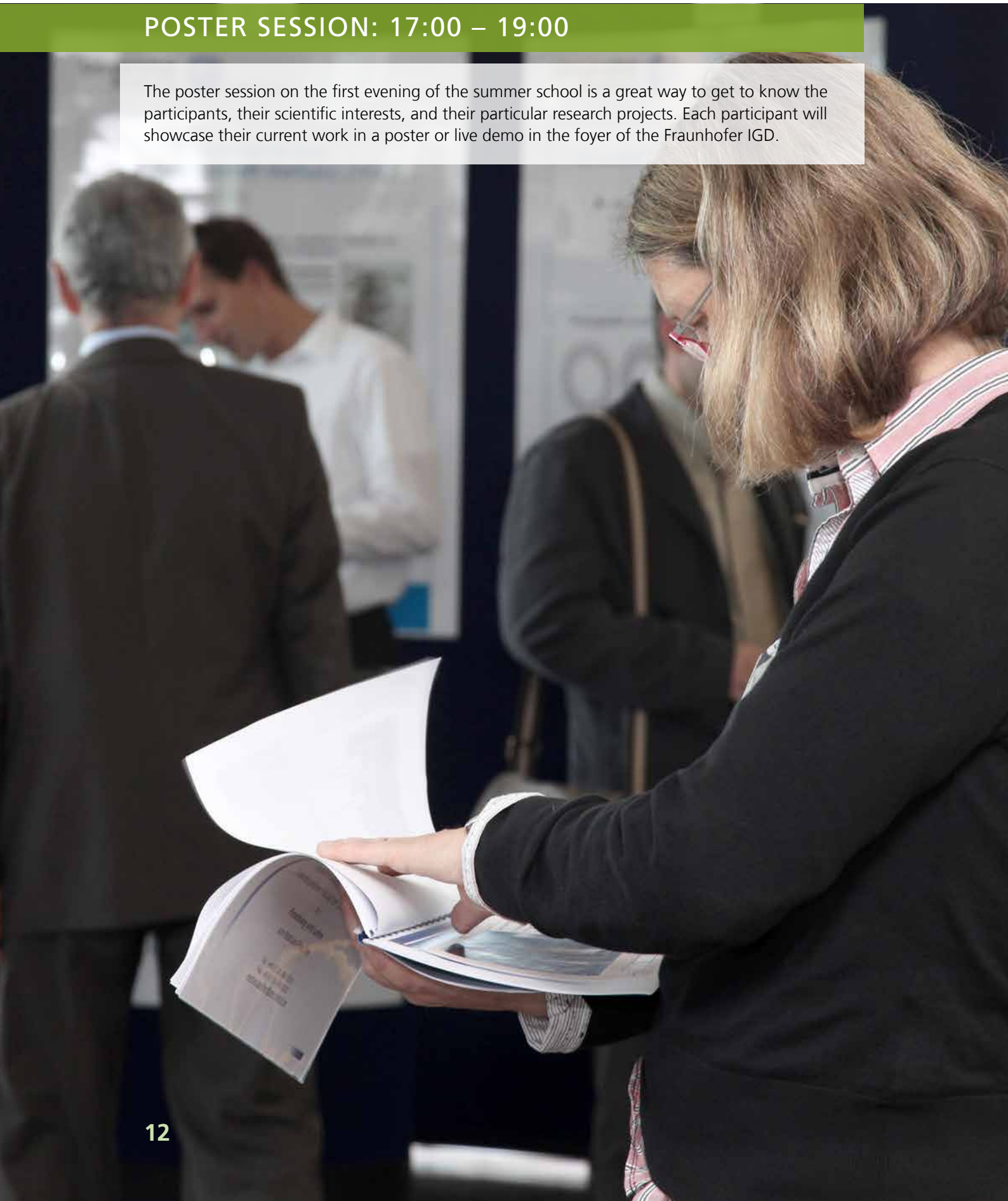
Apart from the lack of monitoring, patients often have a false perception of their current state of health. This includes the over estimation of the current activity levels as well as the under estimation of current stress levels. This lack in self-awareness is contains tremendous health risks.

Technology wise, a serious issue regarding current mobile and/or wearable devices is shown by the variety of devices that are limited to a specific functionality. Thereby, the device often use different protocols, while being designed for the monitoring of a single and very specific type of vital data. This leads to a heterogeneous collection of devices that cannot be used interchangeable. Therefore, a sudden loss of a device leads to a loss in data, due to the fact that redundancy cannot be achieved in this specific setup.

By designing a framework, which incorporates different devices that provide vital information an adaptive anomaly detection setup can be realized. This system could detect and store vital information gapless and provide a detection of health related anomalies in the long and short term. The quality of detection could be further improved by learning the habits and data the user or wearer. Furthermore, the adaptiveness of the framework would enable for a robust recognition that could also deal with noisy data (e.g. varying sensor setups).

POSTER SESSION: 17:00 – 19:00

The poster session on the first evening of the summer school is a great way to get to know the participants, their scientific interests, and their particular research projects. Each participant will showcase their current work in a poster or live demo in the foyer of the Fraunhofer IGD.



TUTORIAL: 8:30 – 12:00

Prof. Dr. Peter Baumann
(Jacobs University Bremen, Germany)
Array Data Management

ABSTRACT

In science and technology, one information category is contributing particularly to today's "Big Data": multi-dimensional arrays. As spatio-temporal sensor, image, simulation, and statistics data they occur in manifold shapes, as never in human history it has been easier and more inexpensive to collect and generate such data at a large scale.

Less easy, however, is access and evaluation. Flexible, scalable services as we know them from relational databases are not possible with conventional technology as such databases do not support n-D arrays. Consequently, today we find ad-hoc built incompatible silo solutions holding "data" (in files) and "metadata" (in databases) in parallel.

Array databases close this gap by offering query languages with declarative array operations which can be massively optimized and parallelized on server side. We present such technology with using the example of rasdaman ("raster data manager"), the pioneer array database which is being used on 100+ TB size datacubes. To this end we look at concepts, language, architecture, optimizations, parallelization as well as applications in the field of "Big Earth Data". Further, we point out how array database concepts are impacting modern "Big Data" standards.

RESEARCH TALK: 13:00 – 13:45

Dr. Christian Beecks
(RWTH Aachen University, Germany)

Similarity Search in Very Large Multimedia Databases

ABSTRACT

With the continuous rise of multimedia, the question of how to access very large multimedia databases efficiently has become of crucial importance. The extensive spread of mobile devices and the rapid expansion of the internet allow users to generate, process, store, and share multimedia data in everyday situations. As an example, the majority of social networking sites such as Facebook, Twitter, Tumblr, and Instagram comprise millions of users that create multimedia data at billion-scale every single day.

The multitude of data and the versatility of information access challenge todays' multimedia databases. In many application areas including information retrieval, data mining, and computer vision, users are no longer satisfied with keyword-based access but want to search, browse, explore, and analyze multimedia databases by content-based characteristics of the multimedia objects. One fundamental operation underlying this content-based information access is similarity search which aims at retrieving the most similar multimedia objects with respect to a query.

In order to carry out similarity search for query-like multimedia objects, the way of modeling similarity is of major significance due to its impact on efficiency and effectiveness. In fact, similarity search requires a formal definition of a similarity model that provides methods for modeling and comparing content-based properties of multimedia objects.

In this talk, we provide an overview of the state-of-the-art approaches to similarity search in very large multimedia databases. We present a generic approach to model similarity between multimedia objects that can be tailored to individual multimedia objects and adapted to the users' notions of perceptual similarity. Based on this similarity model, we discuss various query processing and indexing methods in order to search for similar multimedia objects in very large multimedia databases efficiently and with high accuracy.

STUDENT TALK: 13:45 – 14:15

Steve Dübel
(University of Rostock, Germany)
Flexible Architecture for Raytracing Terrain Height Fields

ABSTRACT

High-quality interactive rendering of terrain surfaces is a challenging task, which requires compromises between rendering quality, rendering time and available resources. However, current solutions typically provide optimized strategies tailored to particular constraints. In this paper we propose a more scalable approach based on functional programming and introduce a flexible ray tracer for rendering terrain heightfields. This permits the dynamic composition of complex and recursive shaders. In order to exploit the concurrency of the GPU for a large number of dynamically created tasks with inter-dependencies, the functional model is represented as a token stream and is iteratively rewritten via pattern matching on multiple shader cores in parallel. A first prototype demonstrates the feasibility of our approach.

STUDENT TALK: 14:15 – 14:45

Rebekka Alm
(Fraunhofer IGD Rostock, University of Rostock, Germany)
Using Digital Annotations as a Means for Asynchronous Information Exchange in Collaborative Work

ABSTRACT

Traditional knowledge management tools are often provided stand-alone and rely on the user to explicitly search for additional information due to a demand regarding his current work task. That means a user that is already under time pressure has to switch between different systems and perform further tedious interactions to gain information. Because of this additional effort, a user might not even look for this information and might thus not value it.

I propose to integrate the knowledge management fully into the user's daily work so he does not have to switch between systems to gain additional information related to his current work task. This automatic provision of context related information may motivate a user to actively share his knowledge.

I propose the usage of ontology-based annotations as an intuitive way to integrate work task related information into an intelligent assistance system and as a means of asynchronous communication between workers. I research how semantically enriched annotations enable their automatic retrieval to provide additional information according to its relevance to a given context.

STUDENT TALK: 15:15 – 15:45

Martin Radolko
(Fraunhofer IGD Rostock, University of Rostock, Germany)

Combining a Gaussian Switch Model with a modified Normalized Cut for Foreground-Background Segregation

ABSTRACT

The low-level task of foreground-background segregation is an important foundation for many high-level computer vision tasks and has been intensively researched in the past. Nonetheless, unregulated environments usually impose challenging problems and often particular difficulties arise from real time requirements. Our approach to this problem uses an efficient novel Background Subtraction algorithm and combines it with a spatial model.

In the first step, the stable background of the scene is modelled with our new Gaussian Switch Model (GSM) and then subtracted from the current frame of the video. The GSM uses two differing stochastical models to represent the background scene at any given time and switches between them according to the recent changes in the scene. This ensures a stable runtime and good results even under difficult circumstances. Albeit these results have no spatial component and will hence not fully reflect the smoothness of natural settings.

Therefore, in the second step, we propose a new energy function to evaluate the spatial relations in a segmentation. It is based on the Normalized Cut, but we adapted these principles to the usage of videos instead of single images. This makes it possible to get a comparable spatial-accuracy as in state of the art approaches (e.g. Markov Random Fields). However, the optimized hierarchical local minimization process for our energy function is at least two orders of magnitude faster. In combination with the efficient GSM Background Subtraction, this results in an accurate real time video segmentation algorithm even for high definition videos.

STUDENT TALK: 15:45 – 16:15

Christian Freischlag
(Hochschule Karlsruhe, Germany)
Semi-Global Matching in OpenCL

ABSTRACT

This thesis deals with computer-aided 3D-reconstruction from stereo camera images. It will examine which preprocessing is necessary to enable a performant processing of stereo images and which features can be utilized for finding a stereo correspondence in these images.

The major part of this thesis deals with analyzing parallelism capabilities of the semi-global-matching algorithm and its implementation on modern graphics hardware. A reference C++ implementation will be written and incrementally ported to the gpu. The upcoming analyzation reveals strong data dependencies and enables further optimizations. In conclusion runtime data will be analyzed to show that real-time processing on modern graphics hardware is possible.

Furthermore, a visualization of the computer vision pipeline in the blind-spot detection context, will be developed.

HOW TO PHD? TRAPS & PITFALLS: 17:00 – 19:00

In most cases, you write a PhD thesis only once in your life. While you are writing, you have no precursor from which to draw guidance or which you can use as a frame of reference. While after completing your PhD and having gathered all the wisdom there is on PhD writing, you will most likely never need this wisdom again, as you move on to other areas.

This panel features three PostDocs who have finished and successfully defended their PhDs over the last few years. They still know of the hardship of coding the necessary software, publishing research articles, and writing up the final thesis. They will share what they have learned over their years as PhD students and answer all your questions on whether in the end the PhD payed off for them. The panelists are:

- Dr. Martin Luboschik, University of Rostock, Germany
- Dr. Roland Ewald, Limbus Medical Technologies GmbH, Rostock, Germany
- Dr. Steffen Hadlak, Fraunhofer IGD Rostock, Germany

TUTORIAL: 8:30 – 12:00

Dr. Anne Jordt
(GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany)

Computer Vision – Established Methods for 3D Reconstruction and their Adaptations to Underwater Imaging

ABSTRACT

Computer vision deals with the problem of automatically extracting information from images, e.g. the 3D information that is lost during image formation. Additionally, tasks like image filtering, motion estimation, image stitching, classification, and recognition are of interest. In short, methods are developed to help the computer understand what it sees in the image. This is a difficult and complex task, especially when considering human abilities of interpreting what they see.

This tutorial aims at giving an overview over methods for 3D reconstruction and will cover established methods that have been in use „in air" for a long time and will then point out which adaptations are necessary for the methods to work on images captured underwater. 3D reconstruction in general receives a dense image sequence (video) or a collection of unordered, overlapping images as input. The images are assumed to show a scene or object of interest for which the 3D information is to be reconstructed.

First, the classic, perspective camera model will be introduced, followed by it its adaptation to underwater image formation, which explicitly incorporates light refraction at the underwater housing. For both, the perspective and refractive camera model, calibration methods will be pointed out. These calibrations can then be utilized in order to retrieve the 3D structure information that was lost in the imaging process and recover the camera motion at the same time. In a first step, called Structure from Motion (SfM), the camera path and a sparse 3D point cloud is computed. For this, methods like relative and absolute pose computation, triangulation, and bundle adjustment are discussed. Afterwards, dense stereo methods allow computing dense depth maps, which are then used to compute a textured 3D model of the scene or object of interest.

RESEARCH TALK: 13:00 – 13:45

Dr. Mario Fritz
(Max-Planck-Institut Saarbrücken, Germany)

Answering Questions about Images

ABSTRACT

We address the task of automatically answering questions about images by bringing together recent advances from natural language processing and computer vision. In order to quantify progress on this challenging problem, we have established the first benchmark for this challenging problem that can be seen as a modern attempt at a visual Turing test.

In our first method, we follow a more traditional AI approach, where we combine discrete reasoning with uncertain predictions by a multi-world approach that represents uncertainty about the perceived world in a Bayesian framework. Our method can handle human questions of high complexity about realistic scenes and replies with range of answer like counts, attributes, object classes, instances and lists of these. The system is directly trained from question-answer pairs.

In a second approach, we build on the recent success of deep learning techniques and propose an end-to-end formulation of this problem for which all parts are trained jointly. By using a Long Short Term Network (LSTM) for modelling language and a Convolutional Neural Network (CNN) for modelling images, we double the performance compared to the first approach. We provide additional insights into the problem by analyzing how much information is contained only in the language part for which we also provide a new human baseline. Further annotations were collected to study human consensus, which is related to the ambiguities inherent in this challenging task.

STUDENT TALK: 13:45 – 14:15

Samuel Zeitvogel
(Hochschule Karlsruhe, Germany)
People Detection and Pose Estimation from Stereo 3D and Monocular Video Data

ABSTRACT

This thesis evaluates potential techniques for fusioning of monocular and stereo data for detection of persons. Using 2D and 3D characteristics this thesis develops a method to detect upright standing persons. The cascading approach uses a 3D-technique to select candidates. These candidates are verified by 2D-techniques. As 2D techniques Deep Convolutional Neural Networks are used. The results of this work show that combining Deep Learning with traditional computer vision methods based on stereo image data is a working concept.

STUDENT TALK: 14:15 – 14:45

Zhiliang Zhou
(Fraunhofer IGD Rostock, University of Rostock, Germany)
Intrinsic Image Decomposition

ABSTRACT

Human can easily recognize objects by color clues or contours, without disturbing of shading and lighting.

However, this ability is not trivial for computer vision applications. If the image can be decomposed into different intrinsic layers, such as lighting, shading and reflectance, then many image processing and computer vision tasks could be significantly simplified.

My current research interests is using wavelet to transform images as sparse signals, than through optimization with reasonable assumptions to solve this intrinsic image decomposition.

STUDENT TALK: 15:15 – 15:45

Fahimeh Farhadifard
(Fraunhofer IGD Rostock, University of Rostock, Germany)
Underwater Image Restoration based on Compressive Sensing

ABSTRACT

Ocean engineering has a strong need for clear and high quality underwater images. Capturing a clear underwater scene is not a trivial task since color cast and scattering caused by the light

attenuation and absorption are common. Therefore, sub-sea images usually suffer from at least one of the following challenges: low contrast, significant blur, limited range and diminished color. The poor quality hinders the automatic segmentation or analysis of the images. In this work, a general image restoration based on compressive sensing is proposed which tackles with blurring caused by light scattering and provides better structural details. We focus on de-blurring and detail enhancement since intensity information are generally more important than color information. This includes both, the human eye as well as most computer vision algorithms. The aim is to use a single degraded underwater image and improve the image quality without any prior knowledge about the scene such as depth, camera-scene distance or water quality, and offers a quality that is typically sufficient for the high level computer vision algorithms.

STUDENT TALK: 15:45 – 16:15

Tim Dolereit
(Fraunhofer IGD Rostock, University of Rostock, Germany)

Underwater Stereo-Camera Calibration

ABSTRACT

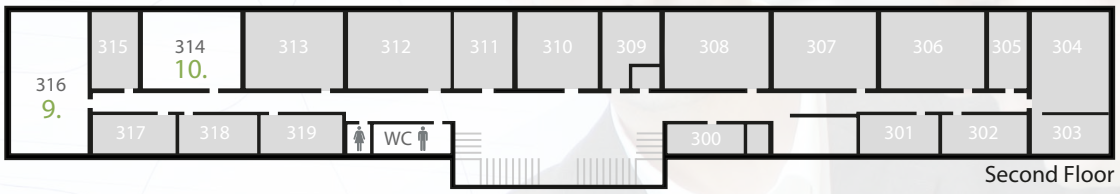
The application of imaging devices in underwater environments has become a common practice. The non-destructive behavior toward marine life and its repeatable application makes underwater imaging an efficient sampling tool. Underwater imaging is confronted with quiet different constraints and challenges than imaging in air. Protecting the camera's constituent electric parts against water leads to setups where cameras are looking through a viewing window like an aquarium or to cameras being placed inside a special waterproof housing. All of these setups are subject to refraction of light passing bounding, transparent interfaces between media with differing refractive indexes (water-glass-air transition). Refractive effects are non-linear and lead to objects seeming to be closer to the observer and hence bigger than they actually are. These effects are a problem for gaining metric information from images like 3D-reconstruction with conventional in air approaches.

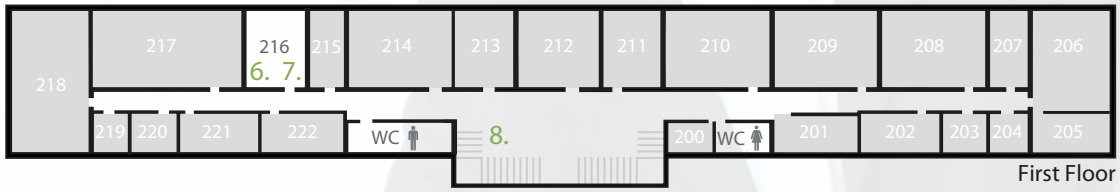
For gaining metric 3D-reconstructions, using a calibrated stereo-camera-system is a common practice. Since the imaging behavior of a camera in air can be well approximated using the linear pinhole camera model of perspective projection, it forms the foundation of most calibration algorithms. Because of refraction, calibration of cameras in underwater usage is theoretically not possible with only the pinhole camera model. Due to the fact that the imaging model does not match the imaging conditions, it is an acknowledged approach to account for refractive effects by modeling them explicitly. Therefore, the pose of the refractive interface towards the cameras has to be calibrated as well. The parameters representing the pose of the refractive interface will be referred to as refractive parameters. These parameters comprise the orientation between a camera's optical axis and a refractive interface's normal, as well as the distance of the camera's center of projection along this normal. Afterward, a physically correct tracing of light rays can be utilized for 3D-reconstruction.

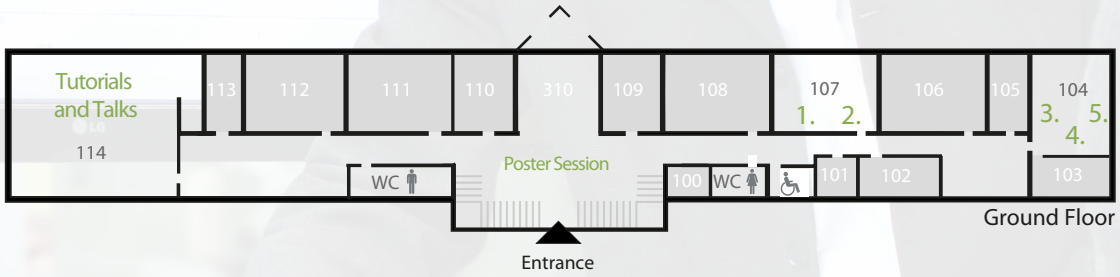
The research topic to be presented comprises the calibration of the refractive parameters of an underwater stereo-camera-system. It will be shown, how this can be realized by utilization of the concept of "virtual object points" from stereo correspondences alone. Therefore, it is possible to eliminate a special calibration object with known 3D geometry from the calibration procedure.

IGD TOUR / OPEN LAB: 17:00 – 19:00

What do you really know about the Fraunhofer IGD Rostock, the institution that hosts the SUMMER SCHOOL? It has something to do with research and computers and graphics, right? Well, this open lab tour will allow you to peek behind the scenes of the research projects at the Fraunhofer IGD Rostock and talk to the involved scientists directly. See our augmented reality demo, get your hands on our 3D visualizations using the large touch tables, and try to outsmart the fall detection in our smart watches!







1. Big Data Analytics for Wireless Ad-Hoc Networks
   Dr. Steffen Hadlak
   Ground Floor | 107
2. Emulation of Holonic Manufacturing Systems
   Ahmed Rabee
   Ground Floor | 107
3. Plant@Hand 3D
   Holger Diener
   Ground Floor | 104
4. Social Augmented Learning
   Andreas Müller
   Ground Floor | 104
5. Plant@Hand Smart Assembly Trolley
   Mario Aehnelt
   Ground Floor | 104
6. Activity Recognition with Smartwatches
   Marian Haescher
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7. Interaction with Wearables
   Denys Matthies
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8. instantPresentation
   Jakob Zabel
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9. Underwater Ground Truth Data
   Tim Dolereit
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10. Underwater Image Enhancement
    Zhiliang Zhou
    Second Floor | 314

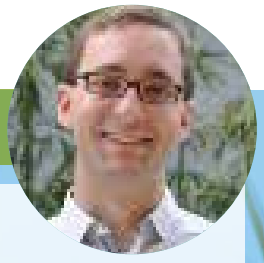
TUTORIAL: 8:30 – 12:00

Lect. Nicolai Marquardt, PhD
(University College London, England)

Human Computer Interaction: Foundations, Principles and Methods

ABSTRACT

Human-Computer Interaction (HCI) is the field of research about investigating and understanding how people currently use digital technology, and about finding ways of how people might be able to use new kinds of technologies and interfaces. This tutorial will give an introduction to the foundations, principles and methods of human-computer interaction and design practice. You will learn about state-of-the-art research and design methods covering a variety of relevant topics, including: methods for establishing the needs of users, qualitative and quantitative methods, strategies for creating solutions to design problems, ways of representing designs through sketching and prototyping, methods of visual design and visual thinking, and the use of testing to ensure a satisfactory outcome.



RESEARCH TALK: 13:00 – 13:45

Prof. Dr. Niels Henze
(University of Stuttgart, Germany)
Mobile & Wearable Computing

ABSTRACT

Over the last 20 years the form factor of computers and the way we interact with them radically changed. Today, interaction with digital devices is not limited to the interaction in a stationary setting. Smartphones and tablets currently replace PCs as the most successful digital device. This development began in the mid-nineties with the mobile phone era. The introduction of the Apple iPhone and the first Android phones marks the era of the smartphone - Internet-connected touchscreen devices that are equipped with a large number of sensors and run third-party applications. There was a major step from feature phones to smartphones. Current mobile devices are, however, merely refinements of devices introduced eight years ago. In this talk we look into current topics in the mobile and wearable interaction domain. The talk include recent work on smart watches, computerized eyeware, mobile head and gaze tracking, as well as deformable mobile devices.

STUDENT TALK: 13:45 – 14:15

Ahmed Sadik
(Fraunhofer IGD Rostock, University of Rostock, Germany)
A Holonic Embedded Control System for a Human-Industrial Robot Cooperative Workcell

ABSTRACT

The main concern under this research topic is to provide an effective model to smartly integrate workers with different set of manufacturing skills into Human-Industrial Robot Safe Cooperative Work Cell. The goal of this concept is to upgrade the cooperative work cell to be a self-adapted and self-aware with its workers resources. Furthermore dynamically assign tasks for every worker resource by matching their skills with product manufacturing needed tasks. The solution model is combining the capabilities of two different control approaches, which are autonomous reactive agent based system and IEC 61499 standard architecture.

IEC 61499 specifications define an implementable reference architecture for the development, reuse and deployment of Function Blocks in distributed and embedded industrial control and automation systems. Meanwhile autonomous reactive agent characterized by being responsive, pro-active, and social which gives it the sense of intelligence.

STUDENT TALK: 14:15 – 14:45

Amin Dadgar
(Technische Universität Chemnitz, Germany)
Hand Gesture Recognition Systems

ABSTRACT

We can categorize hand gesture recognition (HGR) technologies into two broad classes. One of the very first class to recognize hand gesture is marker-based approach in which the subject wears data gloves or put on motion capture system including optical or mechanical sensors. The device is for digitizing the hand and finger motion and their parts into a multi-parametric data. It works very well and is accurate, however its high cost and the difficulty of wearing its tools (user-unfriendly) limits its applicability in many real life scenarios to a great extent [2].

Vision-based class on the other hand provides a noninvasive, easy and natural environment. That is why many research teams are attracted to it. This class of solutions however is still far from generic utility and many technical (mathematical, software and hardware) issues yet to be overcome. Therefor researchers have systematically considered two broad approaches to overcome vision-based problems: model-based approaches and appearance-based approaches.

Appearance-based approaches which can also be considered as „discriminative design approach", use parameters directly derived from images or videos using template database. In other word, step-by-step as much information as possible (e.g. color, texture and motion) are extracted directly from the image or the sequence of images. These pieces of information are then combined in one single feature vector and compared with the parameters of the trained data (e.g. hand gesture) from other datasets. They have advantage of being real time, however their disadvantages are: 1. they are very sensitive to lighting conditions. 2. and cluttered background [2], 3. their performance is influenced a lot by camera movement, 4. and specific user variance [1], 5. they have difficulty to deal with ill-pose or non-singular problems [1].

Model-based approaches which can also be considered as „generative design approach"; use 3D information of key elements such as palm position and joint angles in order to „model" the hand skeleton. Based on this 3D kinematic hand model, they compare the input images and the possible 2D appearance, projected from the 3D hand model to estimate the hand parameters. These approaches are ideal for realistic interactions in virtual environments. However their disadvantages are: 1. the initial parameters for each frame have to be close to the solution to prevent the system to stuck at local minima, 2. they are sensitive to noise in the imaging process, 3. inevitable self-occlusion of the hand cannot be handled, 4. very large image databases are required to cover articulated deformation and different views, 5. they are computationally expensive [1].

The focus of the research I have undertaken, is to advance the state-of-the-art of the HGR system for vision-based class of solutions. My aim is to focus on model-based approaches within Dynamic Bayesian Network (DBN) framework by acquiring Hidden Markov Model (HMM) techniques [3]. Within that context many different variants of HMM such as Cascade-HMM [4], Adaboost-HMM [5], Coupled-HMM and Linked-HMM [6], Neural Network-HMM [7], Input-Output HMM [8], Variable Length Markov Model [9], Hidden Semi Markov Model [10] will be considered. Besides that, potential developments on other areas such as a. estimation techniques to address the ill-pose issue (e.g. Particle Filtering), b. dimensionality reduction techniques to address the high dimensionality issue of the articulated object (e.g. PCA, Gaussian Process Latent Variable Model) and c. feature extraction (image processing) techniques to extract more informative features from 2D input images/videos, will also be investigated.

References:

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2. Garg, Aggarwal, Sofat: Vision-based hand gesture recognition, 2009.
3. Chen, Fu, Huang: Hand gesture recognition using a real-time tracking method and HMM, Taiwan, 2003.
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5. Lv, Nevatia: Recognition and Segmentation of 3D Human Action Using HMM and Multiclass AdaBoost.
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7. McCormick, Vincs, Nahavandi: Teaching a Digital Performing Agent, Using ANN and HMM for recognizing and performing dance movement, 2014.
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9. Liang, Shih, Shih, Liao, Lin: Learning Atomic Human Actions Using Variable Length Markov Model.
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STUDENT TALK: 15:15 – 15:45

Denys Matthies
(Fraunhofer IGD Rostock, University of Rostock, Germany)
Hands-Free and Eyes-Free Peripheral Microinteractions for Wearable Computing

ABSTRACT

Technology is closer to the human than ever and will be even closer in the future. However, we face an operating issue – the control of smart devices is sometimes complicated (e.g. small input space on the screen), awkward (e.g. speech control in a group), inadequate (e.g. binary tasks require complex interaction) or not feasible at all (e.g. hands are already busy), as a control in certain situations can also cause risks (e.g. focusing the screen instead of the road). Alternative control concepts potentially provide new input and output strategies that should consider the users' actual needs and abilities to generate added value for everyday life. In my research I present a variety of approaches on how to enable safe and unobtrusive wearable computing through hands-free and eyes-free peripheral microinteractions. Apparently, not making use of hands potentially enables the users' to continue accomplishing real world tasks. While waiving on the requirement of the visual attention and making use of the humans' ability of peripheral perception, we can make interaction less attention drawing and thus enable mobile computing to be potentially safer. Since sensors and actuators can be integrated into everyday objects, such as wearables, interactions can also potentially designed in a more subtle and unobtrusive way, so they can be more socially acceptable as well. The conducted research strongly focuses on the interaction part between human and computer, while novel alternative concepts have been investigated that offer new opportunities and experiences for mobile computing.

STUDENT TALK: 15:45 – 16:15

Kerstin Blumenstein
(St. Pölten University of Applied Sciences & Vienna University of Technology, Austria)
Interactive Mobile Data Visualization for Second Screen

ABSTRACT

Traditional medial content was consumed with one device at a time. With the increasing simultaneous usage of several different devices like smartphone, tablet and connected TV new approaches for media consumption are conceivable.

One specific instance is a Second Screen scenario where users complement information from unidirectional media broadcasts (i.e. TV) with additional facts from a secondary Internet connected source (e.g. smartphone or tablet).

However Second Screen applications are still in its infancy and very little is known on how to properly design them.

The focus in the PhD thesis will be on the role of data visualizations and how it can be used in Second Screen application for both sides: for the viewer, allowing interactive access to additional, visual, and personalized information that is not included in the broadcast TV content; but also for the TV stations, in order to get richer data about their audience by providing a direct backchannel.

By answering the research questions the complete process of designing and developing interactive data visualization in the context of Second Screen applications for mobile touch devices will be investigated.

In addition to several state-of-the-art reports a tested framework, which includes all relevant parts of a Second Screen application (e.g. content creation, synchronization, different types of visualization), and guidelines for designing and developing mobile data visualization for Second Screen applications, which are synchronized with the broadcast, will be developed.

SOCIAL EVENT: 16:30 – OPEN END

The social event will be held at the Teepott Restaurant in Warnemünde, one of Rostock's landmarks. We will get there by ferry, riding downstream the river Warnow from the inner city. All participants are invited to partake and enjoy an evening of wining and dining in the traditional surroundings of a captain's deckhouse. Afterwards, under the condition of fair weather, there will be the opportunity for a bonfire at the beach.

TUTORIAL: 8:30 – 12:00

Prof. Dr. Marc Streit
(Johannes-Kepler-University Linz, Austria)
Visualization & Visual Analytics

ABSTRACT

Visual analytics is an emerging and fast-developing field that combines the strengths of visualization with the power of analytical reasoning. It supports discovering new and unknown insights by finding relations, patterns, trends, or outliers in potentially large and complex data. Because human analysts' unique sense-making skills are tightly coupled with interactive visualization techniques, visual analytics can lead to discoveries that neither a computer nor a human could make alone. Pairing both in an efficient way is the key to future data analysis and discovery. In this tutorial I will first give a broad overview of state-of-the-art techniques for visualizing various kinds of data, such as tables, graphs, text, and maps. In the second part of the talk I will focus on approaches that the visualization community developed to cope with the particular challenges posed by large and heterogeneous data.

RESEARCH TALK: 13:00 – 13:45

Dr. Thorsten May
(Fraunhofer IGD Darmstadt, Germany)

Patterns in Visual Analytics

ABSTRACT

One of the main ideas of visual analytics is to combine human strengths with automated data analysis via visual-interactive techniques. Visual analytics is approaching its second decade and a plethora of techniques have been proposed so far. In my talk I report on ongoing work to distinguish all these techniques by different patterns of integration. Hence the term "pattern" in my talk is more or less resembling a "design pattern". These integration patterns are in fact non-trivial instantiations of the main idea; reflecting after a decade, it took the visual analytics community at least five years to explore the patterns that are known today. My strongest motivation for developing such patterns is a (perceived) deficit of crisply defined concepts for discourse with young colleagues, students (or customers). Students need to learn how visual analytics systems differ from "pure" visualization or "pure" knowledge discovery at different levels of abstraction. As a symptom of this deficit, our students often needed to take the long road of learning this variety mostly by examples. Thus my talk will basically focus on if (and how) to present the results of a decade in five weeks of a lecture, with a reasonable level of "completeness". The systematization aims towards tightening the definitions to enable discourse without resorting to examples only. Furthermore, it exposes how different approaches relate to each other in terms of a fundamental idea of visual analytics, which is independent from technique, implementation or application.

STUDENT TALK: 13:45 – 14:15

Katarína Furmanová
(Masaryk University, Brno, Czech Republic)
Visualization Techniques for 3D Facial Comparison

ABSTRACT

Many areas, where the facial analysis is used – such as criminal identification or authorization software – are nowadays quickly moving from 2D image to 3D representation. However, with higher dimensionality and complexity of the data also new challenges for its visualization appear. Among the questions which the researchers are posing belong for example the following. How to visualize more than one facial surface without facing occlusions or losing track of data adherence? How to encode the measurements and visualize them to best convey their meaning? How to easily identify correlations between data?

The aim of my work is to deal with some of these challenges and extend the visualization possibilities of the FIDENTIS Analyst application – application for analysis of 3D facial data which is publicly available at www.fidentis.cz. I present three different visualization techniques, each targeted on different issue, in order to provide complex visualization toolbox which could be used not only to visualize the results of the facial analysis but to aid the process itself.

The first proposed technique is suitable for scenarios where two facial models are processed and compared. Here I chose the superposition principle and implemented several adjustments and cues to improve the shape and distance perceptibility, such as the detection and highlight of intersection contours, surface opacity modulations, shadow-casting glyphs indicating surface curvature, and simulation of fog based on the distance between surfaces.

The second method I designed is dedicated to visualization of local shape and variability of datasets consisting of up to 30 models. It is based on the cross-sectional slices. This technique transfers the local data from 3D to 2D view, which reduces the visual complexity and allows the observer to focus on important features of dataset, such as alignment of models, local shape differences or detection of artifacts caused during data acquisition.

The last proposed method employs heat maps to visualize the extensive table-like numerical data representing measurements in very large datasets. The purpose of this tool is to reduce the need for further data post-processing using other applications and provide yet another outlook on the data. To evaluate my visualization techniques I conducted a user study among four scientists working in the area of facial analysis. The results revealed that the scientists found the presented visualization techniques contributory to many areas of their workflow, such as model alignment, shape analysis, or variability analysis.

STUDENT TALK: 14:15 – 14:45

Christina Niederer
(St. Pölten University of Applied Sciences, Austria)

Interactive Visual Exploration of Dynamic Multimodal, Weighted Networks in Data-driven Journalism

ABSTRACT

Albeit the Data-Driven Journalism (DDJ) community is growing significantly, the majority of journalists still face significant obstacles. Two main gaps hinder journalists from utilizing data for their work: the usage gap (usable systems) and the technology gap (dealing with complex heterogeneous data). To bridge these, we aim to develop visualization methods for dynamic multimodal, weighted and directed network data.

In many application areas, data comes with a combination of different characteristics. E.g., social networks inherently come with a temporal aspect to it (e.g., new actors/nodes join the network, new connections/links are made). However, much of the related work in social network visualization disregards the temporal aspect in the data and focuses on visualizing a snapshot of the network [Sedlmair et al., 2012]. Our focus lies on the visualization of quantitative flows in multimodal networks and the temporal developments thereof (which can be modeled as dynamic, directed, weighted, multimodal networks). Only few researchers addressed this topic (e.g., Holten et al., 2007, Viégas et al., 2013) and further research is necessary.

The described research is carried out in the context of the interdisciplinary research project VALiD (Visual Analytics in Data-Driven Journalism) led by Wolfgang Aigner. Use cases of discussed data characteristics are for example the Austrian media transparency database and transfers of professional soccer players. Both data sources can be modeled as networks in combination with quantitative flows along edges (e.g., flow of money between governmental organizations and media companies). In terms of research methods, we will follow Munzner's Nested Model [Munzner, 2009]. Currently, problem characterization and data abstraction are conducted and state of the art research has been performed. Next, interactive visual idioms will be designed. Finally, these will be implemented in the form of interactive prototypes along with user evaluation.

STUDENT TALK: 15:15 – 15:45

Johanna Haider
(Technische Universität Wien, Austria)
Supporting Sensemaking and Insight in Visual Analytics

ABSTRACT

Digital data has the potential to inform us in many ways, but reasoning about discovered clusters, trends, and outliers requires contextualised human judgements. The purpose of Visual Analytics is to enable and discover insights in complex data where automatic computation and interactive visualisation is inevitable. Interactivity is essential to understand and make sense out of data, where sensemaking describes the process of giving meaning to one's experience. With my work I want to investigate interaction processes with visual analytic tools to improve the understanding on how this meaning is generated. My thesis includes an analysis of sensemaking models and their implications for the design of visual analytic tools. My empirical work contributes to a better understanding of these models and, furthermore, supports sensemaking processes in Visual Analytics through tested best practices.

The research is undertaken in the course of the R&D project VALCRI, Visual Analytics for sense-making in Criminal Intelligence Analysis, funded by the EC that is conducted at the Vienna UT in cooperation with sixteen academic and industry partners across Europe. VALCRI aims to produce an integrated software support system for police analysts to investigate crimes and crime-related behaviour with a special focus on designing the technology from cognitive, legal, ethical and privacy perspectives so that the rights of the individual will be respected while ensuring the good of society. It will also make activities more transparent, so that the processes by which conclusions are reached are made easier to inspect. I work on this project since one year and I am pursuing a PhD within in the next three years.

STUDENT TALK: 15:45 – 16:15

Jakob Zabel
(Fraunhofer IGD Rostock, University of Rostock, Germany)
User-driven Data Mining of Marine Sensor Data for Visual Analytics

ABSTRACT

Much data is available of underwater measurements of various types, such as methane concentration, salinity, water temperature and many more. In (oceanographic) research, causalities usually are complex and need to be explored. This has more chances of success, the more data is available but also becomes more effort due to many possible combinations of factors that could potentially be examined. Algorithms that could support the data analysis process, e.g. artificial neural networks, are not easy to parameterize and their results not always easy to interpret. Also, their execution can potentially take more time than the explorative step at hand can justify. So, while an analysis expert knows the techniques that can be used for what kind of data, the domain expert is the one that can interpret the analysis' results and draw conclusions that machines cannot do (yet).

My research goal is to make these useful algorithms more accessible, thus easier to trust and use for the domain expert. A good visualization will be necessary for this as well as concepts that break down an algorithm for use and parameterization in an interactive way. These could be approaches such as localizing execution, approximation or implicit usage of the marine domain. The goal would be to convey what a specific analysis algorithm does without the need to fully understand how it works and to enable fast, preliminary results. Even though the concepts will naturally be tested on only very few analysis algorithms, the goal would be to find concepts that generalize well to other algorithms.

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NOTE

MAP OF ROSTOCK

The SUMMER SCHOOL At-a-Glance

	Monday August 17, 2015	Tuesday August 18, 2015	Wednesday August 19, 2015	Thursday August 20, 2015	Friday August 21, 2015
8:30 – 10:00	Tutorial: **Cognition & Perception** Bernice Rogowitz, PhD P. 6	Tutorial: **Array Data Management** Prof. Peter Baumann P. 13	Tutorial: **Computer Vision** Dr. Anne Jordt P. 18	Tutorial: **Human Computer Interaction** Lect. Nicolai Marquardt, PhD P. 23	Tutorial: **Visualization & Visual Analytics** Prof. Marc Streit P. 30
10:00 – 10:30	**COFFEE BREAK**				
10:30 – 12:00	Tutorial: **Cognition & Perception** continued	Tutorial: **Array Data Management** continued	Tutorial: **Computer Vision** continued	Tutorial: **Human Computer Interaction** continued	Tutorial: **Visualization & Visual Analytics** continued
12:00 – 13:00	**LUNCH**				
13:00 – 13:45	Research Talk: **Advances in Eyetracking** Dr. Michael Burch P. 7	Research Talk: **Similarity Search in Very Large Multimedia Databases** Dr. Christian Beecks P. 14	Research Talk: **Answering Questions about Images** Dr. Mario Fritz P. 19	Research Talk: **Mobile & Wearable Computing** Prof. Dr. Niels Henze P. 24	Research Talk: **Patterns in Visual Analytics** Dr. Thorsten May P. 31
13:45 – 14:45	Student Talks: **Towards Studying the Influence of Information Channel Properties on Visual Scanning Processes** Nina Flad P. 8 **A Survey of Perception and Cognition Aspects Influencing Network Visualization and Visual Network Comparison** Kathrin Ballweg P. 9	Student Talks: **Flexible Architecture for Ray-tracing Terrain Height Fields** Steve Dübel P. 15 **Using Digital Annotations as a Means for Asynchronous Information Exchange in Collaborative Work** Rebekka Alm P. 15	Student Talks: **People Detection and Pose Estimation from Stereo 3D and Monocular Video Data** Samuel Zeitvogel P. 20 **Intrinsic Image Decomposition** Zhiliang Zhou P. 20	Student Talks: **A Holonic Embedded Control System for a Human-Industrial Robot Cooperative Workcell** Ahmed Sadik P. 25 **Hand Gesture Recognition Systems** Amin Dadgar P. 25	Student Talks: **Visualization Techniques for 3D Facial Comparison** Katarína Furmanová P. 32 **Interactive Visual Exploration of Dynamic Multimodal, Weighted Networks in Data-driven Journalism** Christina Niederer P. 33
14:45 – 15:15	**COFFEE BREAK**				
15:15 – 16:15	Student Talks: **Analysis on Body Perception and Distortion using Mixed Reality Environment** Soumya Paul P. 10 **Detecting Anomalies in Vital- and Activity-Data during Low-Amplitude Activities** Marian Haescher P. 11	Student Talks: **Combining a Gaussian Switch Model with a modified Normalized Cut for Foreground-Background Segregation** Martin Radolko P. 16 **Semi-Global Matching in OpenCL** Christian Freischlag P. 17	Student Talks: **Underwater Image Restoration based on Compressive Sensing** Fahimeh Farhadifard P. 20 **Underwater Stereo-Camera Calibration** Tim Dolereit P. 21	Student Talks: **Hands-Free and Eyes-Free Peripheral Microinteractions for Wearable Computing** Denys Matthies P. 27 **Interactive Mobile Data Visualization for Second Screen** Kerstin Blumenstein P. 28	Student Talks: **Supporting Sensemaking and Insight in Visual Analytics** Johanna Haider P. 34 **User-driven Data Mining of Marine Sensor Data for Visual Analytics** Jakob Zabel P. 35
16:15 – 17:00	**RECREATION**				
17:00 – 19:00 (incl. Dinner)	**Poster Session** P. 12	**How to PhD? Traps & Pitfalls** P. 17	**IGD Tour / Open Lab** P. 22	**Social Event** P. 29	

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