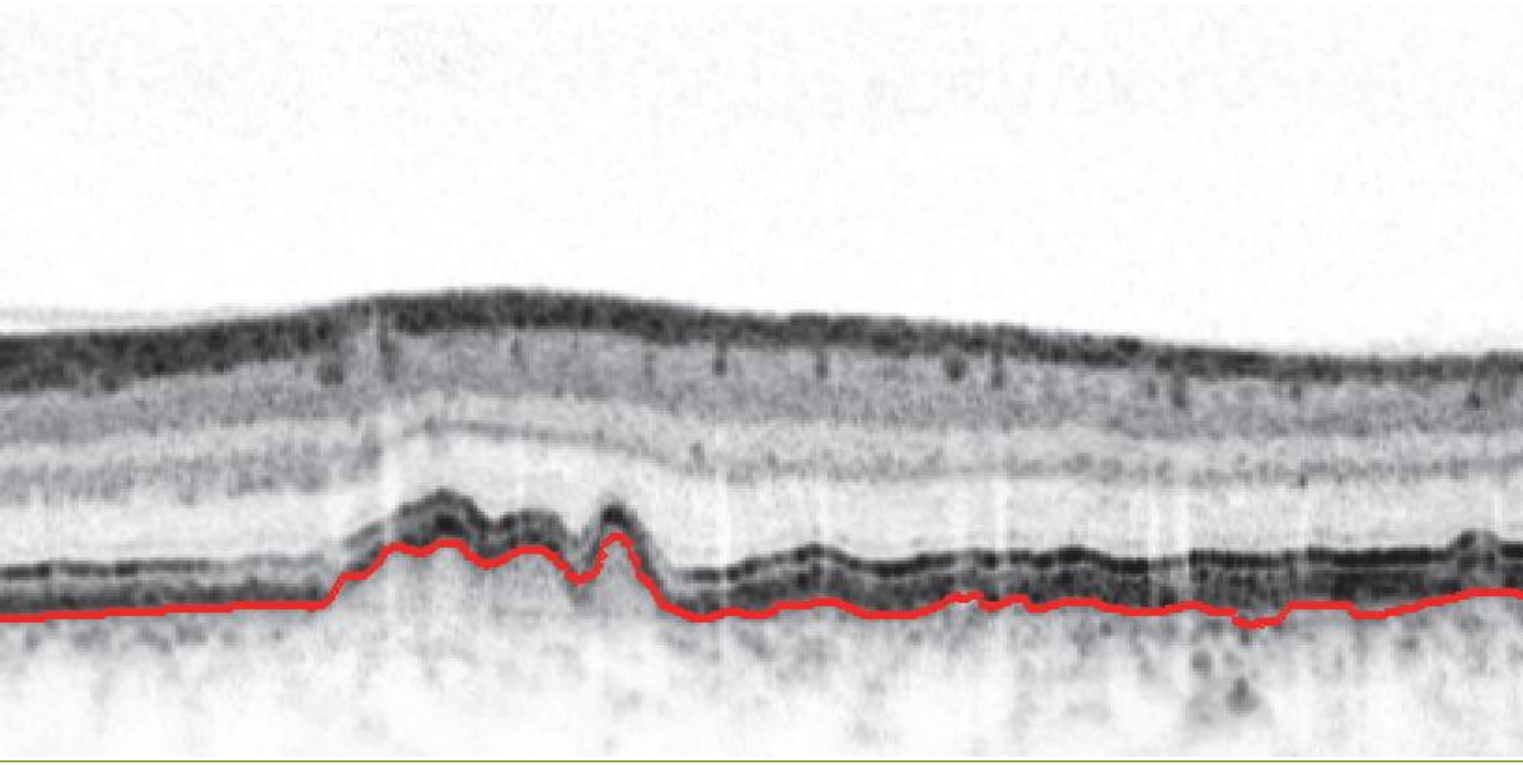
TECHNISCHE UNIVERSITÄT CHEMNITZ

Stiftungsjuniorprofessur
Media Computing



Medical Image and Data Analysis/Ophthalmic Research

Background/Explanation*:* Age-related macular degeneration (AMD), diabetic retinopathy (DR) and glaucoma are leading causes of irreversible blindness especially for older people. For diagnostic imaging, the noninvasive, optical coherence tomography (OCT) as well as eye funduscopy have been used to characterize the retina, retinal pigment epithelium (RPE), drusen complexes, exudates, aneurysms, bleedings and the iridocorneal angle. Additional data comprise diagnostics, treatment, diseases and general patient metadata.

Goal: The goal is to create well-labeled and structured data for automatic diagnoses of pathologies, diseases and to predict the success of treatments and to allow for therapy predictions based on individual factors.

Programming Skills: Python| Matlab | C++| Web-Technology | Database (SQL), …

Subtopics/Methods: image processing, data/text mining, machine/deep learning

https://www.tu-chemnitz.de/informatik/mc/thesis.php

Prework:
https://www.zotero.org/groups/1046750/localizeit/items/
Tags: Ophthalmology

Courses: Computer Science/ (Angewandte) Informatik, Medical Engineering, Biomedizinische Technik, ISGW, Web Engineering, Data Science

Contact/Supervisors: Stefan Kahl, Danny Kowerko

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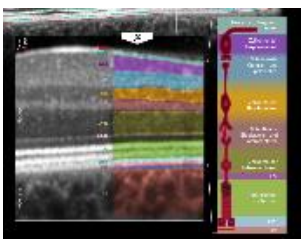
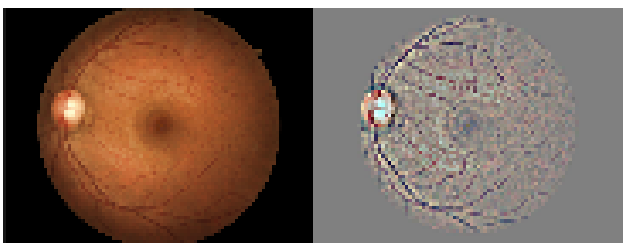
danny.kowerko@informatik.tu-chemnitz.de





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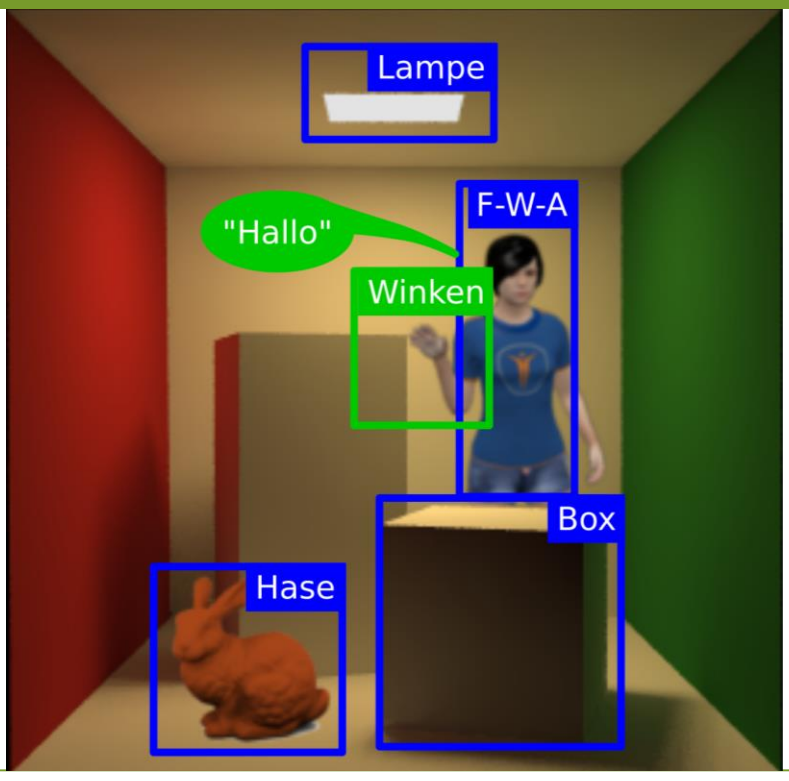

Image and Video Analysis/ Object and Person Detection and Tracking

Background/Explanation*:* Modern computer systems aim to assist people using audio and video sensors, but need to understand and interpret their environment und the activities of people. Recently, the progress in automatic person and object detection is large, still information loss induced by occlusion through obstacles is a serious problem. In our laboratory up to 10 stereo sensors and 56 microphones are used to capture sceneries mimicking real life, helping to train or evaluate algorithms

Goal: The captured data must be combined and analysed to get the understanding of activities and create interpretations of their meaning of each person and object.

Programming Skills: Python | Matlab | C++/OpenCV
Subtopics/Methods: Image & Video Processing, Machine and Deep Learning,

https://www.tu-chemnitz.de/informatik/mc/thesis.php

Prework:
https://www.zotero.org/groups/1046750/localizeit/items Tags: Localisation, Scene Understanding, Person Detection, Human Pose Estimation, Activity Detection

Courses: Computer Science/Informatik, Data Science

Contact/Supervisors: Robert Manthey

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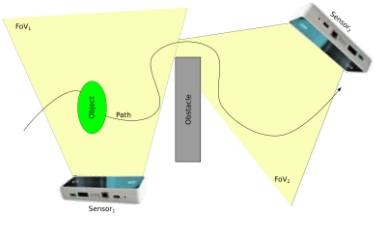

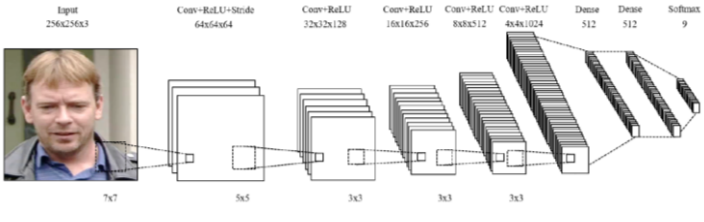

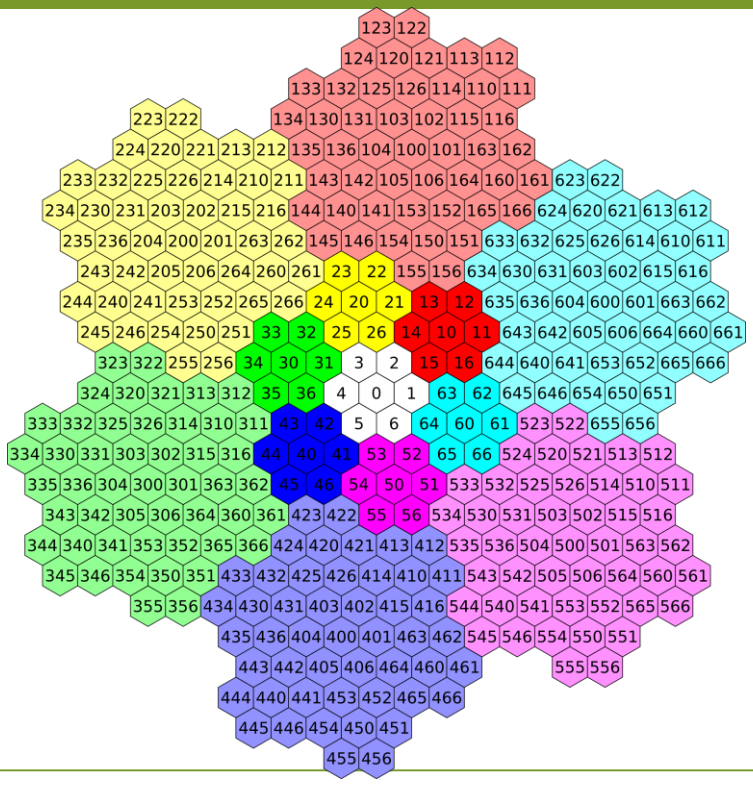

Hexagonal Image and Video Processing

Background/Explanation: *Nearly all modern, technical image processing systems for capture, processing and display use rectangle elements to construct the image. But nearly all* ***biological systems*** *use* ***hexagons*** *regardless of how much eyes they have!*

Goal: The advantages of hexagon structures for image processing are known, but not widely implemented or used. Therefore commonly used algorithms should be adapted to take advantage of the hexagonal structure.

Programming Skills Python, C/C++

Subtopics/Methods: Image&Video Processing,

https://www.tu-chemnitz.de/informatik/mc/thesis.php

Tags: Hexagonal Image Processing

Courses: Computer Science/Informatik, Image Processing

Contact/Supervisors: Robert Manthey

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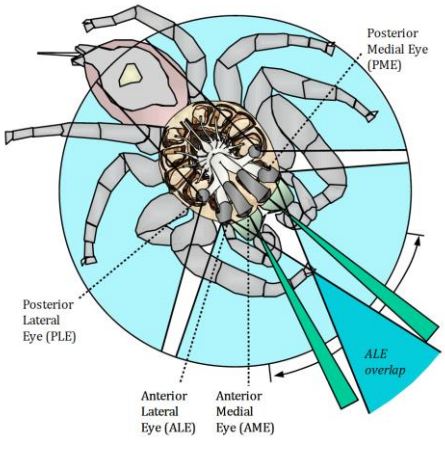

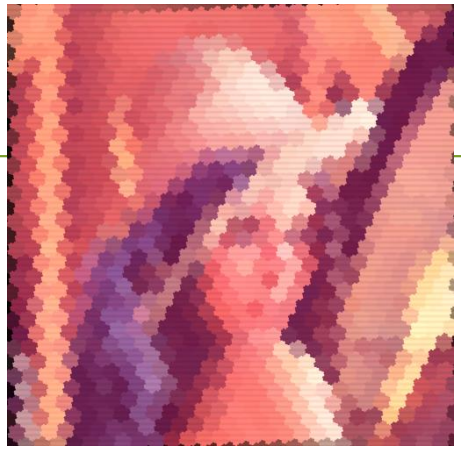

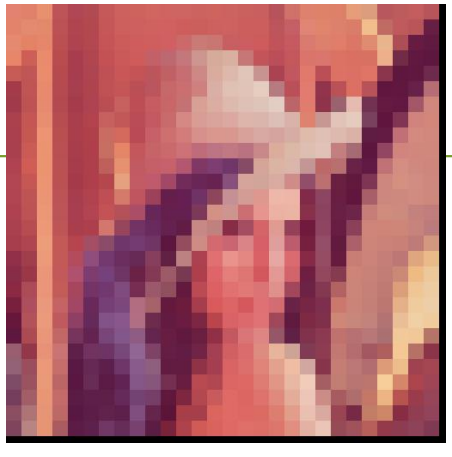

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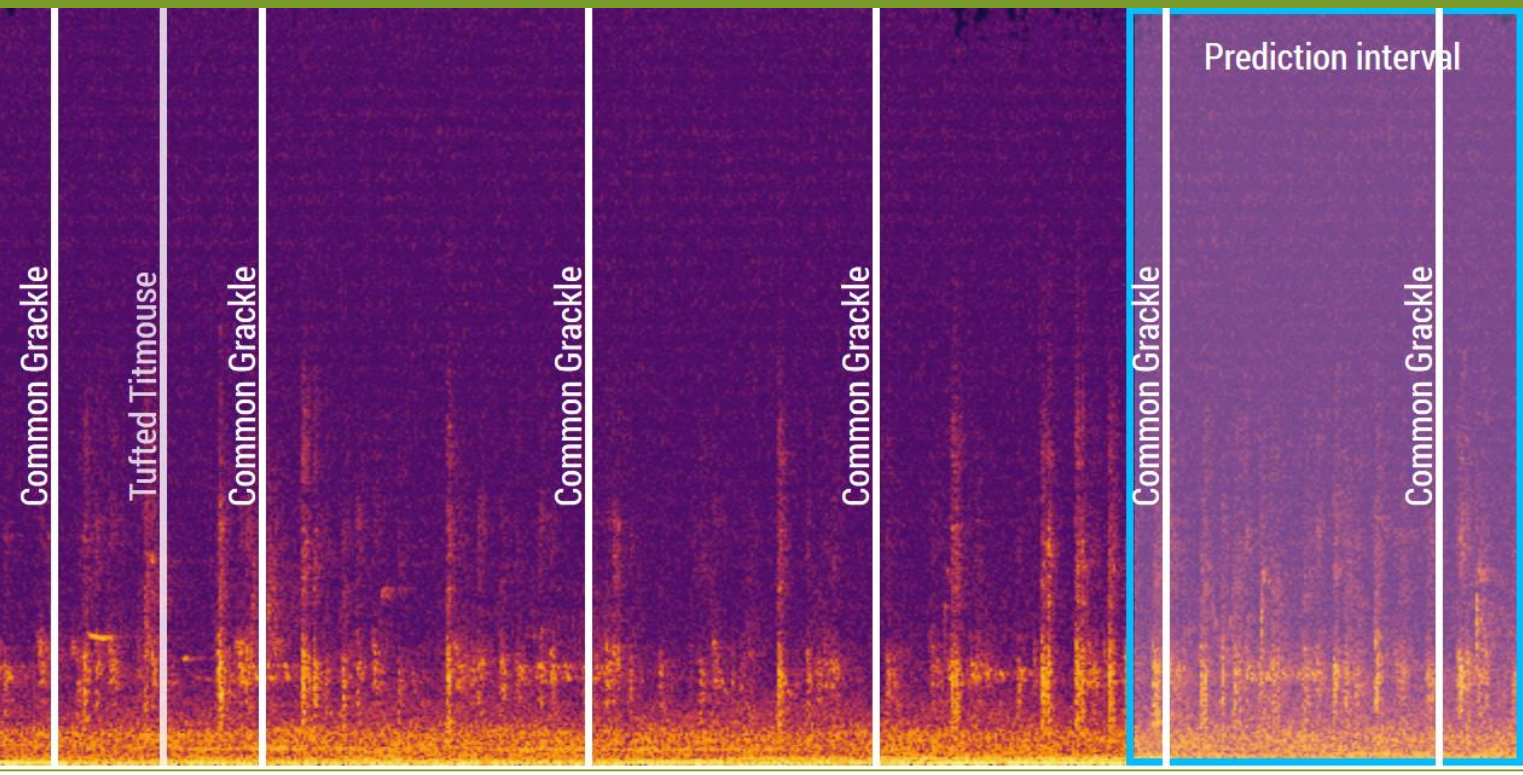

Audio Analysis/ Audio-Classification and Audio-Localisation

Background/Explanation: Acoustic information can be used to identify objects and persons and to estimate their positions in space. Today, many devices and applications such as mobile robots, surveillance systems, human-computer interaction, smart home or ambient assisted living benefit from object/person identification, localisation and tracking.

Goal: Our goal is to detect, classify, localise and track objects and persons in indoor environments using acoustic information. To accomplish this task we use a high number of microphones (64) which simultaneously capture the sound field within our laboratory room. The resulting audio signals are then processed using mainly artificial neural networks, e.g. CNNs, for detection & classification and time difference of arrival and beamforming based algorithms for localization & tracking.

Programming Skills: Matlab | Python | Machine/Deep Learning Frameworks: Theano, Lasagne

Subtopics/Methods: Beamforming, Machine/Deep Learning
https://www.tu-chemnitz.de/informatik/mc/thesis.php

Prework:
https://www.zotero.org/groups/1046750/localizeit/items/
Tags: Acoustic Event Classification, Acoustic Source Localization, Audio, Audio-Processing

Courses: Computer Science, Applied Computer Science, Automotive Software Engineering, Electrical Engineering and Information Technology, Embedded Systems, Information and Communication Systems, Data Science

Contact/Supervisors: René Erler, Stefan Kahl
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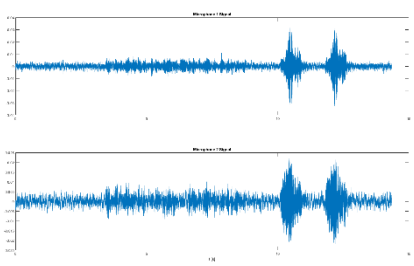

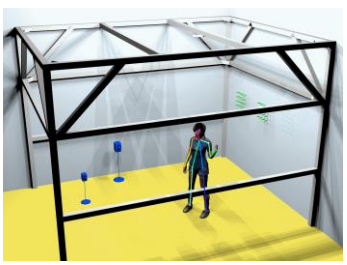

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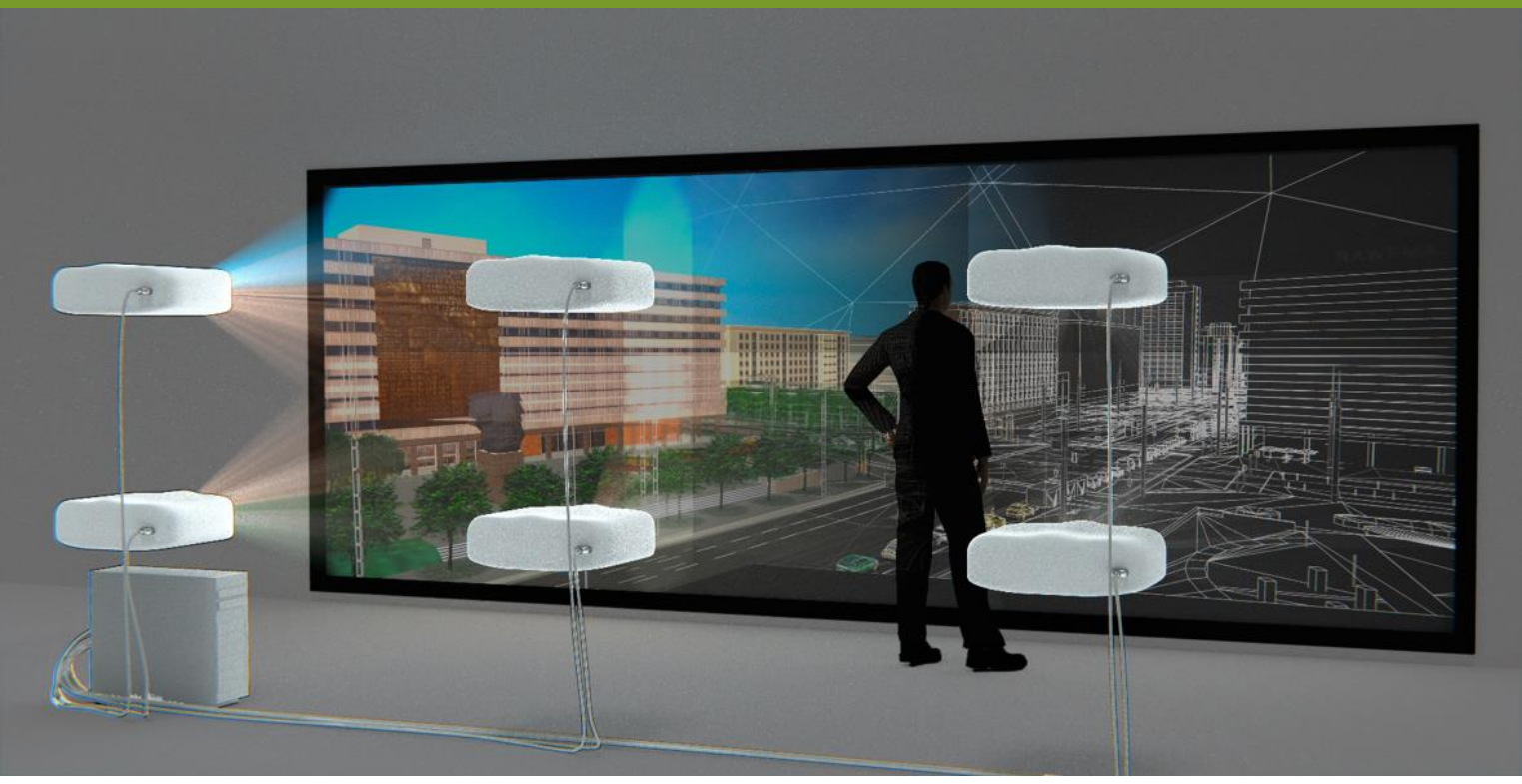

Calibration of Multi-Projector Display Systems

Background*:* To implement large-scale, high-resolution displays, multiple projectors can be combined in such a way that each projector illuminates a separate *tile* of the screen. However, the segmented structure of the display should be concealed from the viewer, so that a homogenous, uniform image is presented on the whole screen. The image data must be adjusted to correct for the geometric alignment and optical distortions as well as the luminance distribution and color deviations in each segment. This is achieved by *calibration techniques* which work by measuring the geometrical as well as photometrical properties of each projector. The resulting calibration parameter sets must be applied to the image data in *real-time*, so that the display can be used for interactive applications or video content.

Goal: The goal is to achieve *perceived photometric uniformity* for several multi-projector display setups (different types of projectors). The calibration process should be fast, robust and user-friendly, so that multi-projector installations can be used an maintained by non-experts.

Subtopics/Methods: Calibration (geometric. Photometric, color), Colorimetry, Image Processing, Video Processing, Video Projector

Programming Skills: C | C++ | Python | Graphics APIs (OpenGL) | GPU Programming (GLSL)

Courses: Computer Science, Computational Science

Contact / Supervisor: Dr. Marcel Heinz

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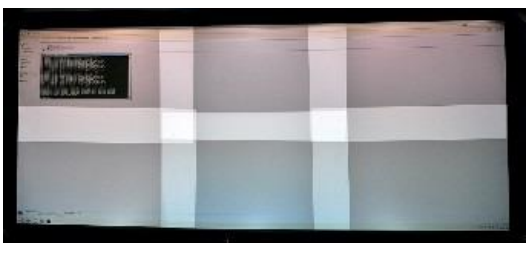

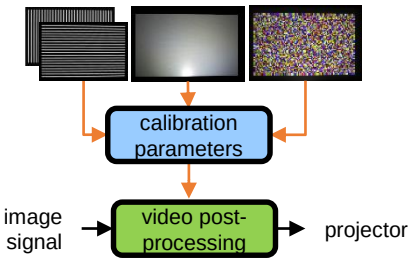

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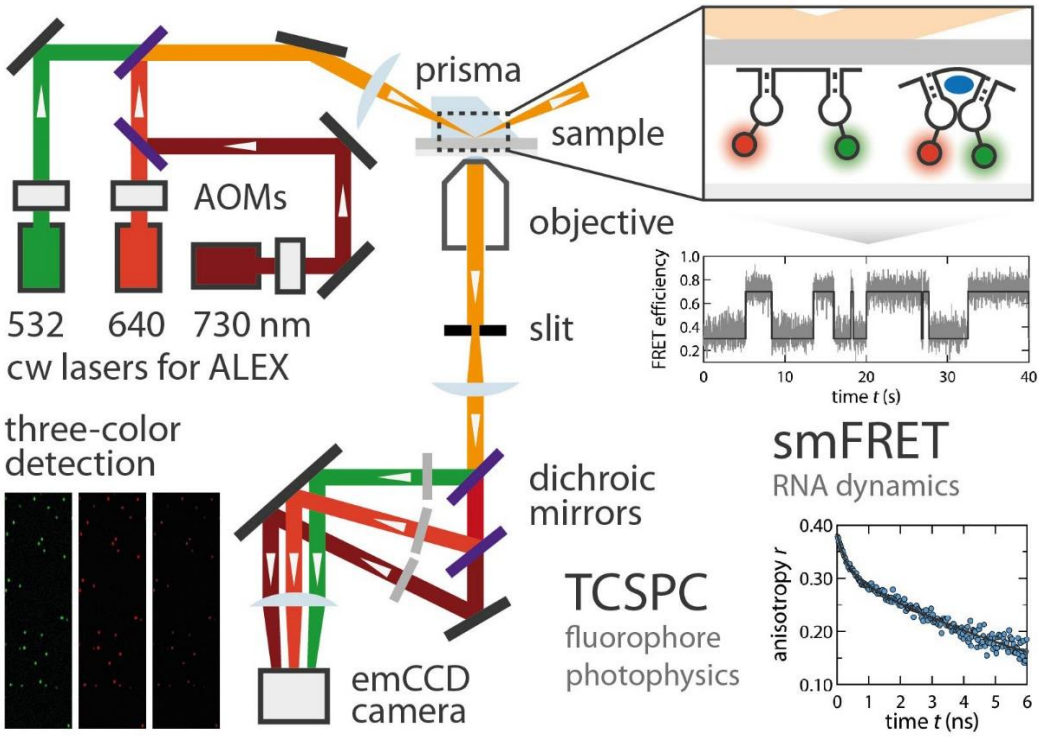

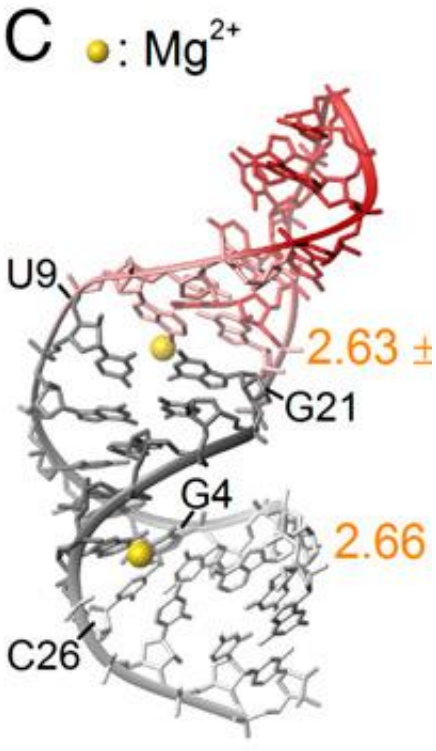

Computational Biology/

(Single Molecule) Microscopy and Biomolecule Analytics

Background:

(Single bio-) Molecule microscopy and spectroscopy has become a powerful tool in physics, chemistry and life science. Data analytics comprises knowledge in image/video processing and algorithmic realization of physical models. Numerous tools and frameworks are developed and enrich the scientific community. Finding the most correct or fast solution from the large diversity of methods and implementations makes is cumbersome.

Goal:

Researchers aim for benchmarks and standardization in the field of microscopy and other life science related techniques (e.g. thermal melting curve analysis) which are in many fields missing and need to be developed.

Further user interface based programs require analysis in terms of ergonomy and learning rates in experiments with their target user group.

Programming Skills: Python| Matlab | C++| Web-Technology | Database (SQL), …

Subtopics/Methods: image processing, regression, visualisation, GUI design, human computer interaction, time-series analysis, microscopy, spectroscopy

https://www.tu-chemnitz.de/informatik/mc/thesis.php

Prework:

https://www.zotero.org/groups/1046750/localizeit/items/

Tags: Single Molecule Fluorescence, Thermal melting curves

Courses: Computer Science/Informatik, Medical Engineering, Biomedizinische Technik, ISGW, Web Engineering, Chemistry, Physics, Data Science

Contact/Supervisors: Titus Keller, Danny Kowerko

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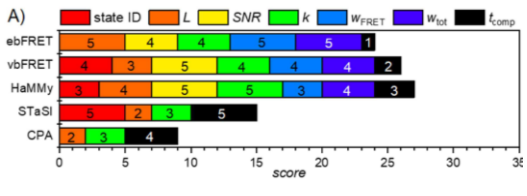
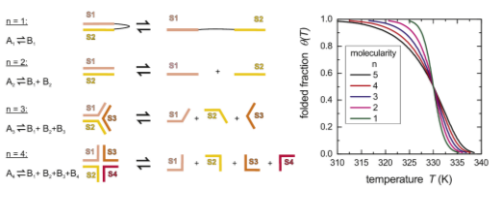


Method Evaluation

Software Development



Thermal Melting Analysis

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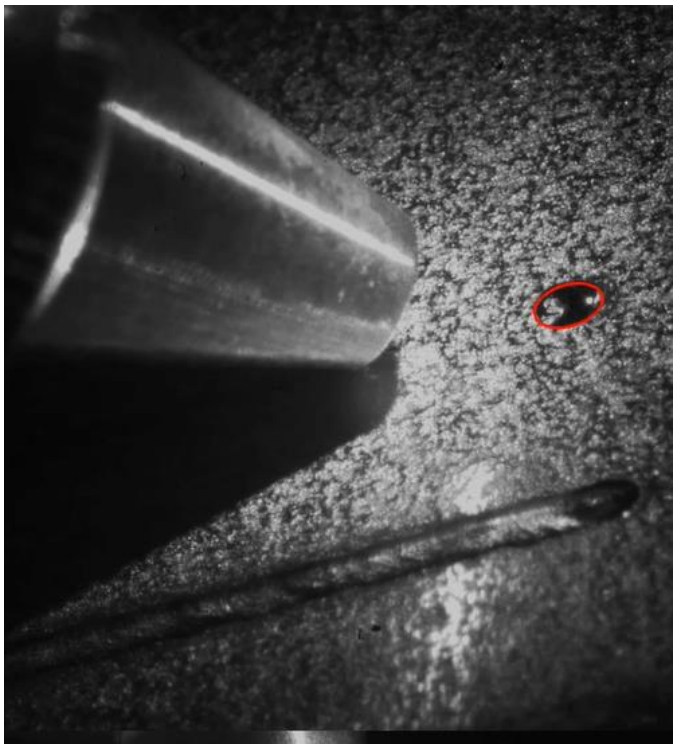

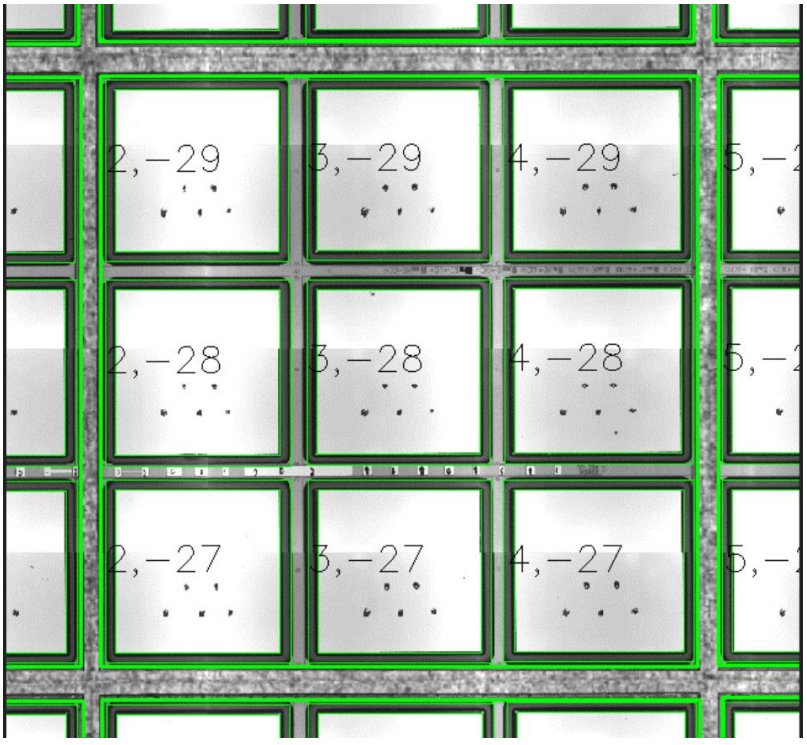

Industrial Image Processing in Machine and Production Systems

Background/Explanation*:* Lasers are used in industrial processes for welding, cutting and other tasks. The quality of the products depends on the laser and machine parameters. Surveillance of laser in-situ is challenging but possible using (high-speed) camera sensors or using optical microscopes and scanning techniques to document the product quality

Goal: Video-, Image- and Data processing methods are developed to monitor and characterize machine processes and the product. Products are e.g. semiconductor wafers which are cut into single chips using laser technology. Here, the aim is to automatically judge and classify the product quality, in terms of damage classes.

Programming Skills Python| Matlab | C++

Subtopics/Methods: : video and image processing, machine/deep learning, regression, visualisation, GUI design, time-series analysis, multi-parameter analysis

https://www.tu-chemnitz.de/informatik/mc/thesis.php

Prework:
https://www.zotero.org/groups/1046750/localizeit/items/

Tags: Image Processing, Video Processing, Laser Welding, Brazing, Regression Analysis

Courses: Computer Science/Informatik, Micro Nano Systems, Physics, Engineering Science, Data Science

Contact/Supervisors: Tobias Schlosser

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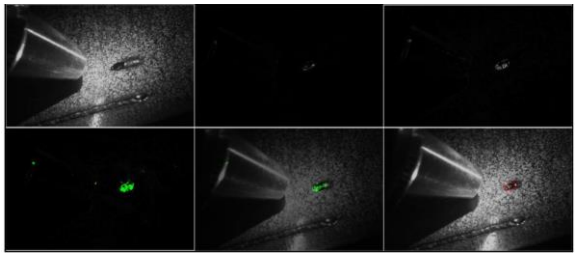

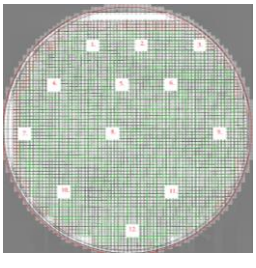

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Web Engineering/ Data and Metadata Handling and Management

Background/Explanation*:* Browser and web applications allow users to quickly assess the functionality of a program without installing the program and/or its dependencies. Interfaces to diverse programming languages allows to create a flexible backend. Their accessibility enhances cooperative working.

Goal: We aim to develop a holistic framework for audio, video, image and IoT sensor data annotation. Therefore not only functionality has to be continuously developed but also the human computer interaction and GUI ergonomics. Further the existing application curvefit.tu-chemnitz.de (app for pre- and post-processing and visualization of xy-data) shall be further developed in terms of visualization, user experience, functionality and ergonomics. Existing video/image processing tools may also be deployed as web app.

Programming Skills Javascript, html/html5, PHP, CSS, SQL, Matlab, Python

Subtopics/Methods: web technology, GUI design, software architecture and ergonomics, MVC

https://www.tu-chemnitz.de/informatik/mc/thesis.php

Prework:
https://www.zotero.org/groups/1046750/localizeit/items/ Tags: Web-Application, Curve Fitting, Thermal melting curves

Courses: Computer Science/Informatik, Web Engineering, Information and Communication Systems

Contact/Supervisors: Danny Kowerko, Stefan Kahl

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