Fraunhofer IGD

*Event guide*

# WELCOME TO THE COMPUTER GRAPHICS NIGHT

## Thursday

November 30, 2023

# CONTENTS

## PROGRAM

# GRADUATION



*THIS SECTION HIGHLIGHTS, IN ALPHABETICAL ORDER, ALL VISUAL COMPUTING DISSERTATIONS PUBLISHED BETWEEN NOVEMBER 1, 2022 AND OCTOBER 31, 2023.*

DANWU CHEN

# Deep learning for characterizing full-color 3D printers: accuracy, robustness, and data-efficiency

dem Fachbereich Informatik
der Technischen Universität Darmstadt
vorzulegende

DISSERTATION

zur Erlangung des akademischen Grades eines
Doktor-Ingenieurs (Dr.-Ing.)
von

Danwu Chen

geboren in Zhanjiang, China

Referenten der Arbeit: Prof. Dr. Arjan Kuijper
Technische Universität Darmstadt
Prof. Dr. techn. Dieter W. Fellner
Technische Universität Darmstadt
Prof. Dr. Philipp Urban
Norwegian University of Science and Technology

Tag der Einreichung: 05/10/2023
Tag der mündlichen Prüfung: 21/11/2023

Darmstädter Dissertation
D 17

ABSTRACT

# Abstract


High-fidelity color and appearance reproduction via multi-material-jetting full-color 3D printing has seen increasing applications, including art and cultural artifacts preservation, product prototypes, game character figurines, stop-motion animated movie, and 3D-printed prostheses such as dental restorations or prosthetic eyes.

To achieve high-quality appearance reproduction via full-color 3D printing, a prerequisite is an accurate *optical printer model* that is a predicting function from an arrangement or ratio of printing materials to the optical/visual properties (e.g. spectral reflectance, color, and translucency) of the resulting print. For appearance 3D printing, the model needs to be inverted to determine the printing material arrangement that reproduces distinct optical/visual properties such as color. Therefore, the accuracy of optical printer models plays a crucial role for the final print quality. The process of fitting an optical printer model's parameters for a printing system is called *optical characterization*, which requires test prints and optical measurements. The objective of developing a printer model is to maximize prediction performance such as accuracy, while minimizing optical characterization efforts including printing, post-processing, and measuring.

In this thesis, I aim at leveraging deep learning to achieve *holistically*-performant optical printer models, in terms of three different performance aspects of optical printer models: 1) *accuracy*, 2) *robustness*, and 3) *data efficiency*.

First, for model accuracy, we propose two deep learning-based printer models that both achieve *high* accuracies with only a moderate number of required training samples. Experiments show that both models outperform the traditional cellular Neugebauer model by large margins: up to 6 times higher accuracy, or, up to 10 times less data for a similar accuracy. The high accuracy could enhance or even enable color- and translucency-critical applications of 3D printing such as dental restorations or prosthetic eyes.

Second, for model robustness, we propose a methodology to induce physically-plausible constraints and smoothness into deep learning-based optical printer models. Experiments show that the model not only almost always corrects implausible relationships between material arrangement and the resulting optical/visual properties, but also ensures significantly smoother predictions. The robustness and smoothness improvements are important to alleviate or avoid unacceptable banding artifacts on textures of the final printouts, particularly for applications where texture details must be preserved, such as for reproducing prosthetic eyes whose texture must match with the companion (healthy) eye.

Finally, for data efficiency, we propose a learning framework that significantly improves printer models' data efficiency by employing *existing* characterization data from *other* printers. We also propose

# ABSTRACT

a contrastive learning-based approach to learn dataset embeddings that are extra inputs required by the aforementioned learning framework. Experiments show that the learning framework can drastically reduce the number of required samples for achieving an application-specific prediction accuracy. For some printers, it requires only 10% of the samples to achieve a similar accuracy as the state-of-the-art model. The significant improvement in data efficiency makes it economically possible to frequently characterize 3D printers to achieve more consistent output across different printers over time, which is crucial for color- and translucency-critical individualized mass production.

With these proposed deep learning-based methodologies significantly improving the three performance aspects (i.e. accuracy, robustness, and data efficiency), a *holistically*-performant optical printer model can be achieved, which is particularly important for color- and translucency-critical applications such as dental restorations or prosthetic eyes.

MEILING FANG

# Boosting the Generalizability and Fairness of Presentation Attack Detection

Zur Erlangung des akademischen Grades Doktor-Ingenieur (Dr.-Ing.)
Genehmigte Dissertation von Meiling Fang aus China
Tag der Einreichung: 09. March 2023, Tag der Prüfung: 21. April 2023

1. Gutachten: Prof.Dr. Arjan Kuijper
2. Gutachten: Prof.Dr. Dieter W. Fellner
3. Gutachten: Prof.Dr. Julian Fierrez
Darmstadt, Technische Universität Darmstadt

TECHNISCHE UNIVERSITÄT DARMSTADT

Computer Science Department

Interactive Graphics Systems Group

ABSTRACT

## Abstract

The vulnerability of biometric recognition to presentation attacks (PAs) has been widely recognized and has attracted increasing attention as it enables attackers to impersonate authentic users. Presentation attack detection (PAD), aiming at automatically catching PAs, is an essential technology to secure biometric systems from PAs such as printed photos and replayed videos. Despite the considerable exploration and remarkable progress in PAD performance, two major issues still constitute a gap in technology. The first is the lack of proper understanding of the fairness of such algorithms over human-related attributes, and the second is the low performance generalizability over variabilities such as unknown attack types and capture environments. These challenges drive the main contributions of this thesis towards analyzing and boosting the fairness and generalizability of PAD.

PAD fairness over different human attributes is extremely understudied. Such under-exploration is mainly due to the lack of suitable data. Towards enabling the fairness assessment and enhancement in face PAD, this thesis first introduces a combined attribute annotated PAD dataset, including both demographic and non-demographic attribute labels. Meanwhile, this thesis presents a new metric, accuracy balanced fairness, to simultaneously represent both the PAD fairness and the absolute PAD performance. Then, a comprehensive analysis of fairness in face PAD is conducted to study its relation to the nature of training data and the methodology of decision threshold selection. Guided by the outcomes of these analyses, a data augmentation method, namely FairSWAP, is successfully proposed to enhance the fairness of face PAD.

In addition to the PAD generalizability over human-related attributes, seen as fairness, another emerging challenge that encountered face PAD during the COVID-19 pandemic is the PAD generalizability to subjects wearing facial masks. To address this issue, this thesis first provides a collaborative real mask attack dataset involving the conventional unmasked bona fide and attacks, masked bona fide sample, novel attacks with faces wearing masks, and attacks with real masks placed on spoof faces. This thesis performs a set of extensive experiments to investigate the impact of masked faces on recognition vulnerability and PAD behaviour. Observing the degradation of PAD performance caused by the facial masks, this thesis presents a solution to target this issue by refining the partial attack supervision and the regional weighted inference.

# ABSTRACT

The third part of this thesis targets the more conventional PAD generalizability issues, such as variabilities in attack creation and capture scenarios. Aiming to boost the generalizability of face PAD, this thesis proposes to leverage the information from the frequency domain in an optimized manner, assisting the information in the spatial domain to learn a more generalized representation under intra-dataset and cross-dataset settings. With a focus on enhancing the generalizability of iris PAD, this thesis proposes a micro-stripe analyses solution that leverages the benefit of the spatially aware processing of well-defined regions in the iris and its border with the sclera. This thesis further introduces a novel attention-based deep pixel-wise binary supervision method, A-PBS, for iris PAD. This solution aims to capture the fine-grained pixel/patch-level attack clues and automatically locate regions that contribute the most to an accurate PAD decision. The generalizability of the proposed iris PAD solutions is demonstrated under real-world cross-testing cases, including cross-attack, cross-dataset, and cross-spectrum settings.

To summarize, this thesis first provides a much-needed comprehensive analysis of fairness in PAD, leading to a well-founded and integrable fairness enhancement solution. Then, it presents detailed investigations of the masked face PAD challenge along with a technical solution towards improving the masked face PAD performance. The thesis then presents a set of novel contributions to boost the generalizability of face and iris PAD techniques. This thesis thus yields practically-aware advancements in understanding and mitigating vulnerabilities of biometric systems and lays the groundwork for future research into developing and deploying generalized PAD systems.

# CAMILA GONZALEZ

# Lifelong Learning in the Clinical Open World

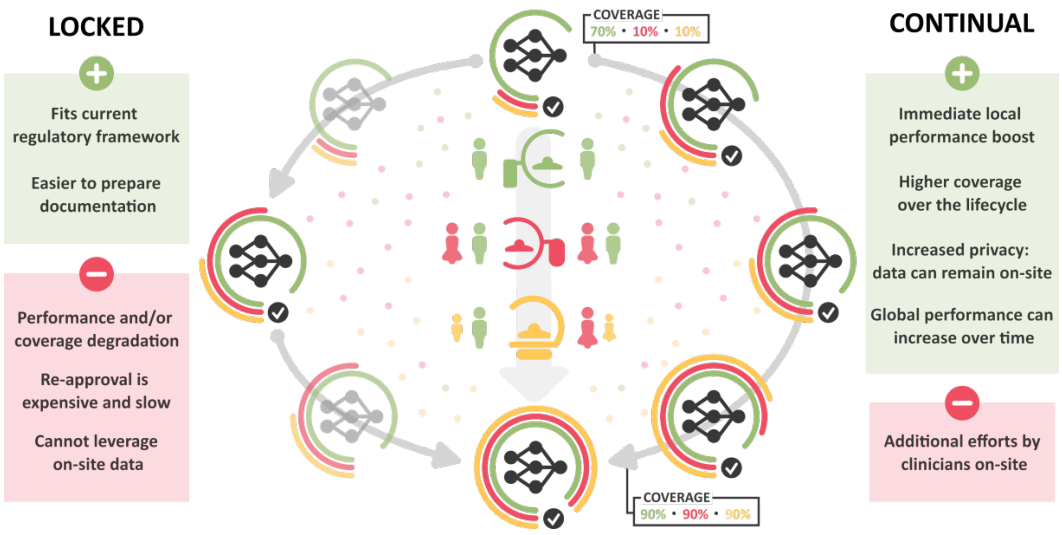
at the Computer Science Faculty
of the Technischen Universität Darmstadt

approved in fulfillment of the requirements for the degree of
Doktor-Ingenieur (Dr.-Ing.)

**Doctoral thesis by Camila González**

**First assessor:** Anirban Mukhopadhyay, Ph.D.
**Second assessor:** Prof. Dr. techn. Dr.-Ing. eh. Dieter W. Fellner
**Third assessor:** Prof. Tianming Liu, Ph.D.

**Darmstadt, 2023**





## Abstract

Despite mounting evidence that data drift causes deep learning models to deteriorate over time, the majority of medical imaging research is developed for – and evaluated on – static close-world environments. There have been exciting advances in the automatic detection and segmentation of diagnostically-relevant findings. Yet the few studies that attempt to validate their performance in actual clinics are met with disappointing results and little utility as perceived by healthcare professionals. This is largely due to the many factors that introduce shifts in medical image data distribution, from changes in the acquisition practices to naturally occurring variations in the patient population and disease manifestation. If we truly wish to leverage deep learning technologies to alleviate the workload of clinicians and drive forward the democratization of health care, we must move away from close-world assumptions and start designing systems for the *dynamic open world*.

This entails, first, the establishment of reliable quality assurance mechanisms with methods from the fields of uncertainty estimation, out-of-distribution detection, and domain-aware prediction appraisal. Part I of the thesis summarizes my contributions to this area. I first propose two approaches that identify outliers by monitoring a self-supervised objective or by quantifying the distance to training samples in a low-dimensional latent space. I then explore how to maximize the diversity among members of a deep ensemble for improved calibration and robustness; and present a lightweight method to detect low-quality lung lesion segmentation masks using domain knowledge.

Of course, detecting failures is only the first step. We ideally want to train models that are reliable in the open world for a large portion of the data. Out-of-distribution generalization and domain adaptation may increase robustness, but only to a certain extent. As time goes on, models can only maintain acceptable performance if they *continue learning* with newly acquired cases that reflect changes in the data distribution. The goal of continual learning is to adapt to changes in the environment without forgetting previous knowledge. One practical strategy to approach this is *expansion*, whereby multiple parametrizations of the model are trained and the most appropriate one is selected during inference. In the second part of the thesis, I present two expansion-based methods that do not rely on information regarding *when* or *how* the data distribution changes.

Even when appropriate mechanisms are in place to fail safely and accumulate knowledge over time, this will only translate to clinical usage insofar as the regulatory framework allows it. Current regulations in the USA and European Union only authorize *locked* systems that do not learn post-deployment. Fortunately, regulatory bodies are noting the need for a modern *lifecycle regulatory approach*. I review these efforts, along with other practical aspects of developing systems that learn through their lifecycle, in the third part of the thesis.

We are finally at a stage where healthcare professionals and regulators are embracing deep learning. The number of commercially available diagnostic radiology systems is also quickly rising. This opens up our chance – and responsibility – to show that these systems can be safe and effective throughout their lifespan.

# STEFAN LENGAUER

Dipl.-Ing. Stefan Lengauer, BSc BSc

# Crossmodal Search, Visual Exploration, and Restoration of Digital Pottery Artifacts

**DISSERTATION**
to achieve the university degree of
Doctor of Technical Sciences

submitted to
**Graz University of Technology**

Supervisor
Univ.-Prof. Dr. Tobias Schreck
Institute of Computer Graphics and Knowledge Visualisation

Co-Reviewer and Examiner
Jun.-Prof. Dr. Hubert Mara
Institute for Computer Science
Martin-Luther-University Halle-Wittenberg Graz, November 2022

# ABSTRACT

## Abstract

One of the most important archaeological cues for the study of ancient civilizations is pottery, which makes up by far the largest group of excavated artifacts, since every new excavation effort potentially yields up thousands of fragments. Similar to the humanities in general, this research area, belonging to the field of Cultural Heritage (CH), experienced several ambitious digitization efforts in the last two decades. The resulting digital surrogates enable the application of computerized tools, which can support tedious manual processes. 3D ,in particular, has become a state-of-the-art data modality for the documentation of numerous types of exhibits. This can be attributed to both the more easily affordable capturing hardware and freely available software suites for the easy archiving and analysis of 3D data. However, not only newly unearthed objects but also decades old documentations of excavated ceramics have been digitized to a large extent and made publicly accessible via online repositories and collections.

On the downside, the efficient browsing of such repositories as well as – one of the most important use cases for archaeological research – the content-based searching for object similarity is seldomly supported. Instead, most platforms allow to filter their collections based solely on associated metadata. As this information is incomplete, erroneous, or missing altogether for many entries, a potentially large number of relevant records could easily be overlooked. Also, this type of querying could result in an unmanageably large result set (without any relevance ordering), if those properties cannot be determined selectively enough. This stresses the need for specialized retrieval systems, which allow posing queries in a content-based manner, meaning that the data itself, *e.g.*, an image or 3D model, is the basis for a search. This type of retrieval has been researched for decades, scenarios where the query and the search space exhibit different data modalities, *e.g.*, 3D model vs. profile curve, is still a sparsely addressed problem. As such scenarios are, however, particularly relevant for researchers of the CH domain, respective retrieval systems have to be capable of both supporting different modalities and bridging modal boundaries.

Orthogonal to the problem of content-based searching is the visualization and interactive exploration of (large) object collections with the goal of unveiling similarity clusters. Respective techniques allow an archaeologist to detect cross-correlations among object traits; discover (yet unknown) links, since related objects, or even parts of the same object, are often scattered across different museums; and generate hypotheses regarding ancient trade routes or workshops. At the same time, visualization enables the exposition and presentation of CH artifacts as virtual museums and exhibitions.

Finally, digital reconstruction approaches support the efficient generation of shape and texture hypotheses by automatizing the workflow of an archaeologist who leverages both a vessel's symmetry properties and sequential structures to approximate missing geometry and surface painting. Digital methods are also a viable alternative to physical reconstruction, which is most of the time not feasible due to cost and labor considerations or not even allowed because of the fragile nature of CH artifacts.

# ABSTRACT

This thesis provides contributions to all the three mentioned archaeological processes with computer-aided techniques, relying on established as well as newly developed techniques of computer vision and knowledge visualization. Within the context of content-based retrieval, a new query modality (3D+Sketch), particularly suited for the search based on incomplete pottery artifacts, is presented. Newly designed annotation workflows, benchmark datasets, and evaluation metrics pave the way for both the training of learning-based retrieval techniques and the comparative evaluation of methods. In terms of visualization, a novel interactive linked view exploration system supports the uninterrupted exploration of annotated datasets concurrently along different object traits. Finally, in terms of reconstruction, the textual completion of worn off surface paintings is studied. To this end, a novel approach is presented which, first of all, determines the generation grammar of an ornament sequence in order to detect gaps and fill them with plausible texture. All of these techniques are able to reduce the required labor *w.r.t.* their currently used purely manual counterparts significantly. Their viability and relevance for archaeological use cases has been continuously evaluated with collaborating archaeologists who also aided in the design and execution of both qualitative and quantitative evaluations. Even though the proposed concepts are experimental, they will hopefully find their way into the everyday archaeological use.

# DIRK SIEGMUND

## Image Classification of High Variant Objects in Fast Industrial Applications

dem Fachbereich Informatik
der Technischen Universität Darmstadt
vorzulegende

DISSERTATION

zur Erlangung des akademischen Grades eines
Doktor-Ingenieurs (Dr.-Ing.)
von

M.A. Dirk Siegmund

Potsdam, Deutschland

| | |
|---|---|
| Referenten der Arbeit: | Prof. Dr. Arjan Kuijper<br>Technische Universität Darmstadt<br>Prof. Dr. techn. Dr.-Ing. eh. Dieter W. Fellner<br>Technische Universität Darmstadt<br>Prof. Dr. Fabrizzio Soares<br>Universidade Federal de Goiás |
| Tag der Einreichung: | 20/09/2023 |
| Tag der mündlichen Prüfung: | |

Darmstädter Dissertation
D 17

ABSTRACT

# Abstract

Recent advances in machine learning and image processing have expanded the applications of computer vision in many industries. In industrial applications, image classification is a crucial task since high variant objects present difficult problems because of their variety and constant change in attributes. Computer vision algorithms can function effectively in complex environments, working alongside human operators to enhance efficiency and data accuracy. However, there are still many industries facing difficulties with automation that have not yet been properly solved and put into practice. They have the need for more accurate, convenient, and faster methods. These solutions drove my interest in combining multiple learning strategies as well as sensors and image formats to enable the use of computer vision for these applications. The motivation for this work is to answer a number of research questions that aim to mitigate current problems in hinder their practical application. This work therefore aims to present solutions that contribute to enabling these solutions. I demonstrate why standard methods cannot simply be applied to an existing problem. Each method must be customized to the specific application scenario in order to obtain a working solution.

One example is face recognition where the classification performance is crucial for the system's ability to correctly identify individuals. Additional features would allow higher accuracy, robustness, safety, and make presentation attacks more difficult. The detection of attempted attacks is critical for the acceptance of such systems and significantly impacts the applicability of biometrics. Another application is tailgating detection at automated entrance gates. Especially in high security environments it is important to prevent that authorized persons can take an unauthorized person into the secured area. There is a plethora of technology that seem potentially suitable but there are several practical factors to consider that increase or decrease applicability depending which method is used. The third application covered in this thesis is the classification of textiles when they are not spread out. Finding certain properties on them is complex, as these properties might be inside a fold, or differ in appearance because of shadows and position.

The first part of this work provides in-depth analysis of the three individual applications, including background information that is needed to understand the research topic and its proposed solutions. It includes the state of the art in the area for all researched applications. In the second part of this work, methods are presented to facilitate or enable the industrial applicability of the presented applications. New image databases are initially presented for all three application areas. In the case of biometrics, three methods that identify and improve specific performance parameters are shown. It will be shown how melanin face pigmentation (MFP) features can be extracted and used for classification in face recognition and PAD applications. In the entrance control application, the focus is on the sensor information with six methods being presented in detail. This includes the use of thermal images to detect humans based on their body heat, depth images in form of RGB-D images and 2D image series, as well as data of a floor mounted sensor-grid. For textile defect detection several methods and a novel classification procedure, in free-fall is presented.

In summary, this work examines computer vision applications for their practical industrial applicability and presents solutions to mitigate the identified problems. In contrast to previous work, the proposed approaches are (a) effective in improving classification performance (b) fast in execution and (c) easily integrated into existing processes and equipment.

## JULIAN VON WILMSDORFF

# Passive Electric Field Sensing for Ubiquitous and Environmental Perception

Zur Erlangung des akademischen Grades Doktor-Ingenieur (Dr.-Ing.)
Genehmigte Dissertation von Julian von Wilmsdorff aus Speyer
Tag der Einreichung: 10. August 2022, Tag der Prüfung: 28. November 2022

1. Gutachten: Prof. Dr. Dieter W. Fellner
2. Gutachten: Prof. Dr. Arjan Kuijper
3. Gutachten: Prof. Dr. Matthias Hollick
Darmstadt

TECHNISCHE UNIVERSITÄT DARMSTADT

Computer Science Department

Fraunhofer Institut für graphische Datenverarbeitung




# Abstract

Electric Field Sensing plays an important role in the research branches of Environmental Perception as well as in Ubiquitous Computing. Environmental Perception aims to collect data of the surroundings, while Ubiquitous Computing has the objective of making computing available at any time. This includes the integration of sensors to perceive environmental influences in an unobtrusive way.

Electric Field Sensing, also referenced as Capacitive Sensing, is an often used sensing modality in these research fields, for example, to detect the presence of persons or to locate touches and interactions on user interfaces. Electric Field Sensing has a number of advantages over other technologies, such as the fact that Capacitive Sensing does not require direct line-of-sight contact with the object being sensed and that the sensing system can be compact in design. These advantages facilitate high integrability and allow the collection of data as required in Environmental Perception, as well as the invisible incorporation into a user's environment, needed in Ubiquitous Computing.

However, disadvantages are often attributed to Capacitive Sensing principles, such as a low sensing range of only a few centimeters and the generation of electric fields, which wastes energy and has several more problems concerning the implementation. As shown in this thesis, this only affects a subset of this sensing technology. Therefore, this thesis focuses on the mainly open area of Passive Electric Field Sensing in the context of Ubiquitous Computing and Environmental Perception, as active Capacitive Sensing is an open research field which already gains a lot of attention. The thesis is divided into three main research questions.

First, I address the question of whether and how Passive Electric Field Sensing can be made available in a cost-effective and simple manner. To this end, I present various techniques for reducing installation costs and simplifying the handling of these sensor systems.

After the question of low-cost applicability, I examine for which applications passive electric field sensor technology is suitable at all. Therefore I present several fields of application where Passive Electric Field Sensing data can be collected.

Taking into account the possible fields of application, this work is finally dedicated to the optimization of Passive Electric Field Sensing in these cases of application. For this purpose,

# ABSTRACT

different, already known signal processing methods are investigated for their application for Passive Electric Field sensor data. Furthermore, besides these software optimizations, hardware optimizations for the improved use of the technology are presented.

# BEST THESIS AWARD

## THE JUDGING PROCESS

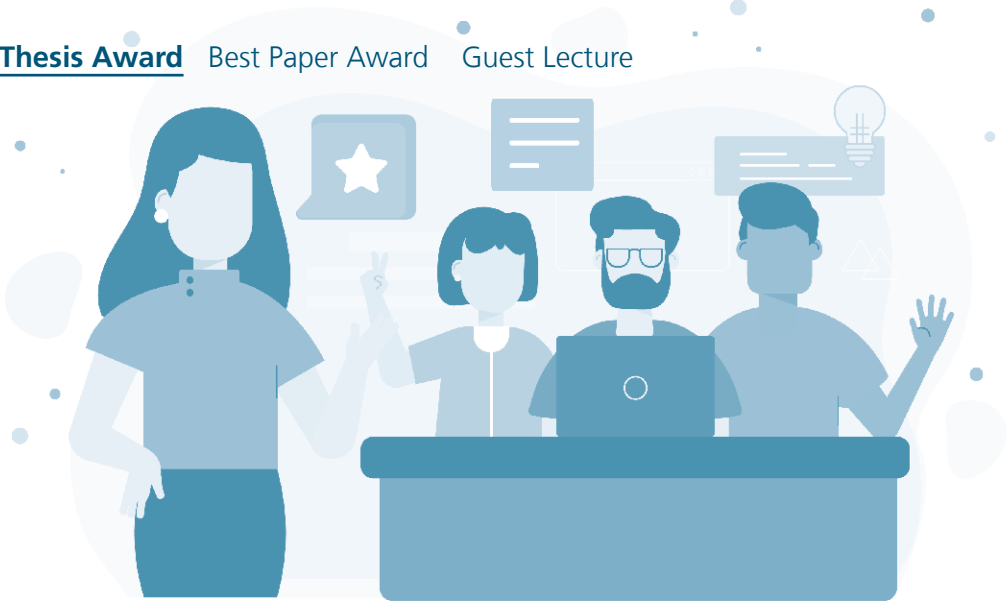
The judges select the bachelor's and master's theses they consider the best of those submitted for the Visual Computing Cluster between November 2022 and October 2023. These winning theses demonstrate high quality both with respect to scientific achievement and presentation.

The theses are chosen by the judges in collaboration with the theses supervisors. As the scope of visual computing is very broad, the winning theses are not ranked.

## THE PRIZE

The winners receive a certificate, a book, and a trip to a Eurographics or equivalent leading visual computing conference, agreed by the winners with the judges.

THE WINNERS OF THE **BEST THESIS AWARD** WILL BE ANNOUNCED AT THE COMPUTER GRAPHICS NIGHT EVENT.



# PANEL OF JUDGES
## BEST THESIS AWARD

### FINAL NOMINATIONS

**Jonas Burian** BACHELOR

Modelling of Perturbations in Seismocardiography Signals

**Jonas Henry Grebe** Master

Identity Synthesis via Latent Diffusion Models for Accurate Face Recognition

**Patrick Johann Hergan** MASTER

Robust Covariance Mesh Reconstruction

**Marcel Klemt** Master

On the development of face recognition using synthetic data and unsupervised representation learning

**Anh thi Luu** BACHELOR

Investigating the Performance Gap in Face Recognition Models Trained on Real or Synthetic Data

**Louis Rethfeld** BACHELOR

Exploring the utility of face pixels with shapely values

**Maximilian Schwalenberg** BACHELOR

Height estimation of wind turbines using neural networks and the fusion of image and geoinformation

### THE JUDGES

*Dr. Gerald Bieber*
*Fraunhofer IGD*

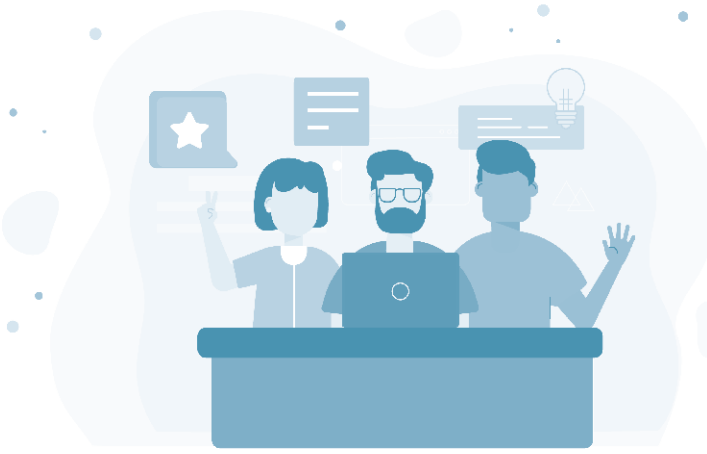
*Prof. A. Kuijper*
*Fraunhofer IGD*

# BEST PAPER AWARD

*THE FOLLOWING SECTION HIGHLIGHTS ALL NOMINATED PUBLICATIONS AND WORKS WORTHY OF DISTINCTION. THE WINNERS OF THE **BEST PAPER AWARD** WILL BE ANNOUNCED AT THE COMPUTER GRAPHICS NIGHT EVENT.*

# PANEL OF JUDGES

## BEST PAPER AWARD



### THE JUDGING PROCESS

The chair of the independent panel of judges receives forty selected papers for the Visual Computing Cluster in 2023 considered to be the best by the Fraunhofer IGD competence center heads and the professors of affiliated university groups. These papers span a wide range of research fields, including human computer interaction, computer graphics, computer vision, modeling, visual search and analysis and visual inference, medical computing and simulation.

The first task is to classify the papers into categories according to their impact on business, science, or society. Each paper is initially ranked by each judge based on three scores: 1) how relevant the paper is to the corresponding category, 2) the quality of the paper, and 3) how familiar the judge is with the topic (confidence value).

In the second step, scores for all papers are collected from all the judges, and the papers are each assigned to at least one category. Then the three best-ranked papers within an individual category are nominated. In addition, any papers that score at least one 'outstanding' grading by one of the judges are nominated.

Finally, the judges meet to discuss all nominated papers.
Two papers are selected as 'honorable mention' papers and one paper is selected as the 'best paper' for each of the categories.

### THE JUDGES

*Prof. R. Klein*
*Univ. Bonn (chair)*

*Prof. J. Gall*
*Univ. Bonn*

*Prof. H. Lentsch*
*Univ. Tübingen*

*Prof. M. Magnor,*
*TU Braunschweig*

*Prof. G. Zachmann*
*Univ. Bremen*

### THE PRIZE

The honorable mentions and the best paper authors receive a certificate. The authors of the best paper in the categories "Impact on business," "Impact on science," "Impact on society" also receive a book and a monetary prize.

# FINAL NOMINATIONS
## BEST PAPER AWARD

# IMPACT ON BUSINESS

Da Col, Giacomo (Fraunhofer Austria Research GmbH)
Teppan, Erich C. (Fraunhofer Austria Research GmbH)
**Industrial-size Job Shop Scheduling with Constraint Programming**

Schufrin, Marija (Fraunhofer IGD / TU Darmstadt GRIS)
Lücke-Tieke, Hendrik (Fraunhofer IGD)
Kohlhammer, Jörn (Fraunhofer IGD / TU Darmstadt GRIS)
**Visual Firewall Log Analysis - At the Border Between Analytical and Appealing**

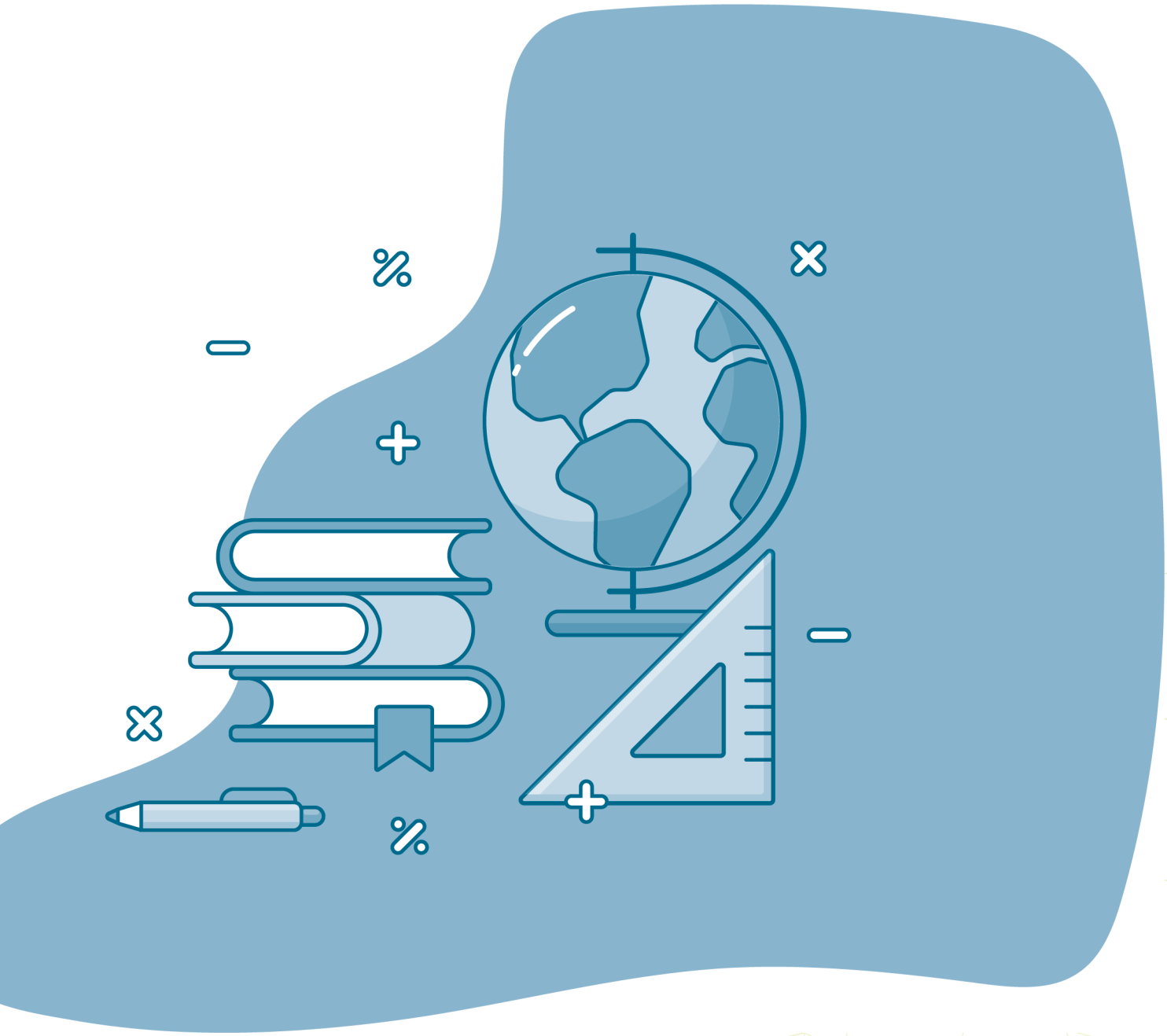
Gorschlüter, Felix (Fraunhofer IGD / TU Darmstadt GRIS)
Rojtberg, Pavel (Fraunhofer IGD / TU Darmstadt GRIS)
Pöllabauer, Thomas Jürgen (Fraunhofer IGD / TU Darmstadt GRIS)
**A Survey of 6D Object Detection Based on 3D Models for Industrial Applications**

Boutros, Fadi (Fraunhofer IGD / TU Darmstadt GRIS)
Siebke, Patrick (Fraunhofer IGD)
Klemt, Marcel (Fraunhofer IGD)
Damer, Naser (Fraunhofer IGD / TU Darmstadt GRIS)
Kirchbuchner, Florian (Fraunhofer IGD / TU Darmstadt GRIS)
Kuijper, Arjan (Fraunhofer IGD / TU Darmstadt MAVC)
**PocketNet: Extreme Lightweight Face Recognition Network Using Neural Architecture Search and Multistep Knowledge Distillation**

Damer, Naser (Fraunhofer IGD / TU Darmstadt GRIS)
López, César Augusto Fontanillo (KU Leuven)
Fang, Meiling (Fraunhofer IGD / TU Darmstadt GRIS)
Spiller, Noemie (Fraunhofer IGD)
Pham, Minh Vu (Fraunhofer IGD)
Boutros, Fadi (Fraunhofer IGD / TU Darmstadt GRIS)
**Privacy-friendly Synthetic Data for the Development of Face Morphing Attack Detectors**

Ströter, Daniel (TU Darmstadt GRIS)
Mueller-Roemer, Johannes Sebastian (Fraunhofer IGD / TU Darmstadt GRIS)
Weber, Daniel (Fraunhofer IGD / TU Darmstadt GRIS)
Fellner, Dieter (Fraunhofer IGD / TU Darmstadt GRIS / TU Graz CGV)
**Fast Harmonic Tetrahedral Mesh Optimization**

# FINAL NOMINATIONS
## BEST PAPER AWARD



# IMPACT ON SCIENCE

Ströter, Daniel (TU Darmstadt GRIS)
Mueller-Roemer, Johannes Sebastian (Fraunhofer IGD / TU Darmstadt GRIS)
Weber, Daniel (Fraunhofer IGD / TU Darmstadt GRIS)
Fellner, Dieter (Fraunhofer IGD / TU Darmstadt GRIS / TU Graz CGV)
**Fast Harmonic Tetrahedral Mesh Optimization**

Buelow, Max von (TU Darmstadt GRIS)
Riemann, Kai
Guthe, Stefan (Fraunhofer IGD / TU Darmstadt GRIS)
Fellner, Dieter (Fraunhofer IGD / TU Darmstadt GRIS / TU Graz CGV)
**Profiling and Visualizing GPU Memory Access and Cache Behavior of Ray Tracers**

Rezgui, Ghassen (University of Tunis El Manar)
Marzougui, Hamed (University of Tunis El Manar)
Lili, Taieb (University of Tunis El Manar)
Preiner, Reinhold (TU Graz CGV)
Ceccobello, Chiara (Chalmers Univ. of Technology)
**Thermal Conduction Effects on the Accretion ejection Mechanism. Outflow Process Investigation**

Morsy Abdelkader Morsy, Mostafa (Fraunhofer IGD / TU Darmstadt GRIS)
Brunton, Alan (Fraunhofer IGD)
Urban, Philipp (Fraunhofer IGD / Norwegian University of Science and Technology NTNU)
**Shape Dithering for 3D Printing**

Cibulski, Lena (Fraunhofer IGD)
May, Thorsten (Fraunhofer IGD)
Schmidt, Johanna (Zentrum für Virtual Reality und Visualisierung Forschungs-GmbH, Vienna)
Kohlhammer, Jörn (Fraunhofer IGD / TU Darmstadt GRIS)
**COMPO*SED: Composite Parallel Coordinates for Co-Dependent Multi-Attribute Choices**

Boutros, Fadi (Fraunhofer IGD / TU Darmstadt GRIS)
Damer, Naser (Fraunhofer IGD / TU Darmstadt GRIS)
Kirchbuchner, Florian (Fraunhofer IGD / TU Darmstadt GRIS)
Kuijper, Arjan (Fraunhofer IGD / TU Darmstadt MAVC)
**ElasticFace: Elastic Margin Loss for Deep Face Recognition**

# FINAL NOMINATIONS
## BEST PAPER AWARD

# IMPACT ON SOCIETY

Wagner, Nicolas (TU Darmstadt GRIS)
Fuchs, Moritz (TU Darmstadt GRIS)
Tolkach, Yuri (Uniklinik Köln)
Mukhopadhyay, Anirban (TU Darmstadt GRIS)
**Federated Stain Normalization for Computational Pathology**

Gotkowski, Karol (Applied Computer Vision Lab, Helmholtz Imaging)
González, Camila (TU Darmstadt GRIS)
Kaltenborn, Isabel (Universitätsklinikum Frankfurt)
Fischbach, Ricarda (Universitätsklinikum Frankfurt)
Bucher, Andreas (Universitätsklinikum Frankfurt)
Mukhopadhyay, Anirban (TU Darmstadt GRIS)
**i3Deep: Efficient 3D interactive segmentation with the nnU-Net**

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González, Camila (TU Darmstadt GRIS)
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Abb, Benjamin (Fraunhofer IGD)
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Kuijper, Arjan (Fraunhofer IGD / TU Darmstadt MAVC)
**Stating Comparison Score Uncertainty and Verification Decision Confidence Towards Transparent Face Recognition**

# GUEST LECTURE

## Professor Justus Thies, TU Darmstadt

### RESEARCH IN THE PARTNER UNIVERSITIES

Justus Thies is a full professor for 3D Graphics and Vision at TU Darmstadt and an independent research group leader at the Max Planck Institute for Intelligent Systems in Tübingen. His research focuses on three-dimensional sensing of people and of the objects or environments, with which they interact. His international research team employs methods from artificial intelligence, computer graphics, and machine vision. Justus Thies is best known for his work on "Digital Humans", which facilitates the creation of virtual images of humans that can be applied, for example, to telecon-ferencing applications in virtual reality (the so-called "Metaverse"). He was a pioneer in the investigation of the potential misuse of the underlying techniques (e.g. deep fakes) and has developed methods that can detect synthetic media.

Justus Thies was awarded a doctorate in Computer Science at Friedrich-Alexander University in Erlangen in 2017 for his dissertation on "Markerless Motion Tracking and Facial Reenactment". During his PhD studies, he worked at the Fraunhofer Institute for Integrated Circuits, at the Max Planck Institute for Computer Science and at Stanford University. Between 2017 and 2021, he was a postdoctoral researcher at TU München, investigating the topic areas of "Digital Humans" and "Neural Ren-dering". In 2021, he became a research group leader at the Max Planck Institute for Intelligent Systems where he set up the Neural Capture & Synthesis group, which he continues to lead. Since September 2023, he has occupied himself with establishing the 3D Graphics & Vision chair at TU Darmstadt.

# GUEST LECTURE

## Professor Stefan Müller, Universität Koblenz

### MY PATH AFTER

Professor Stefan Müller has headed the Computer Graphics Group in the Department of Computer Science at the University of Koblenz since July 2002. He is also Executive Director of the Institute for Computational Visualistics. He received his doctorate in 1995 at the Technical University of Darmstadt where he worked as a department head in the area of Virtual Reality and Augmented Reality at Fraunhofer IGD until 2002. His special areas of research are photorealistic computer graphics, real-time rendering, simulation and mixed reality.
His main area of interest continues to be the use of new media in teaching.

# VISUAL
# VIRTUAL
# DIGITAL

*OUR THANKS TO OUR COLLEAGUES FOR THEIR EXCELLENT WORK AND OUTSTANDING ACHIEVEMENTS*

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VISUAL COMPUTING

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