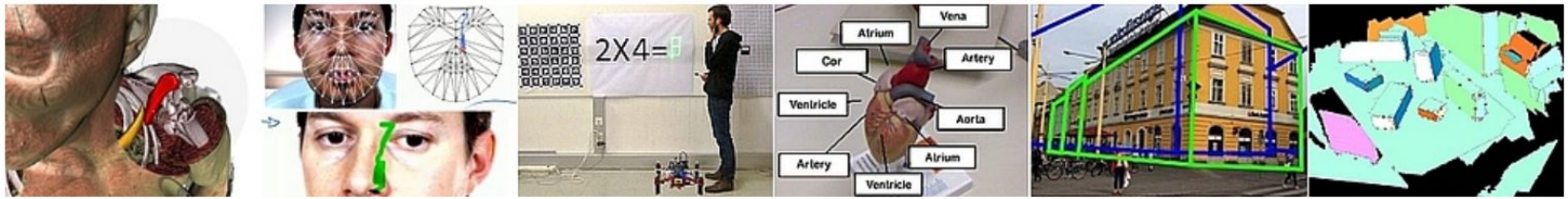
Institute of Computer Graphics and Vision (ICG)



Head: Prof. Thomas Pock

Mission Statement: Graphics Meets Vision

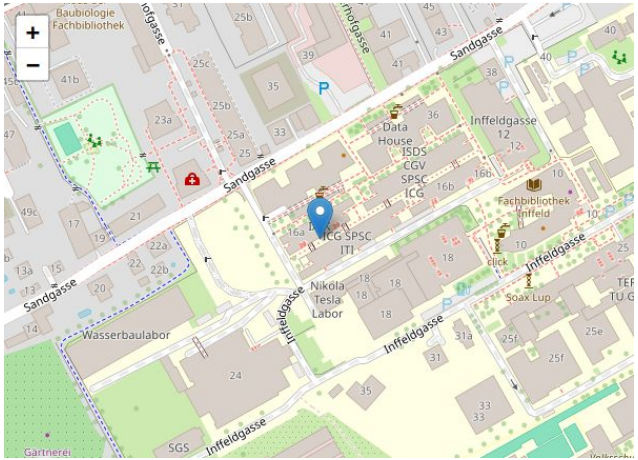
We are the only Austrian academic group with the charter to address all of visual computing, encompassing both computer vision and computer graphics.

Visualization, rendering, virtual reality, augmented reality, object recognition, numerical optimization, GPU programming, 3D reconstruction, machine learning, medical imaging and robot vision.

ICG – Key Data

- Founded: 1992 by Franz Leberl (Em. Univ.-Prof.)
- **Currently 2 Full Professors:** Thomas Pock (Head), Friedrich Fraundorfer
- **3 Associate Professors**: Denis Kalkofen, Markus Steinberger, Alexander Plopski

- Members total: 70
- Publications 2023: 79
- Master theses 2023: 21 (421 in total)
- PhD theses 2023: 7 (158 in total)



Research Topics

enFaced – Instant Augmented Reality Visualization and Navigation in Maxillofacial Surgery

Motivation:

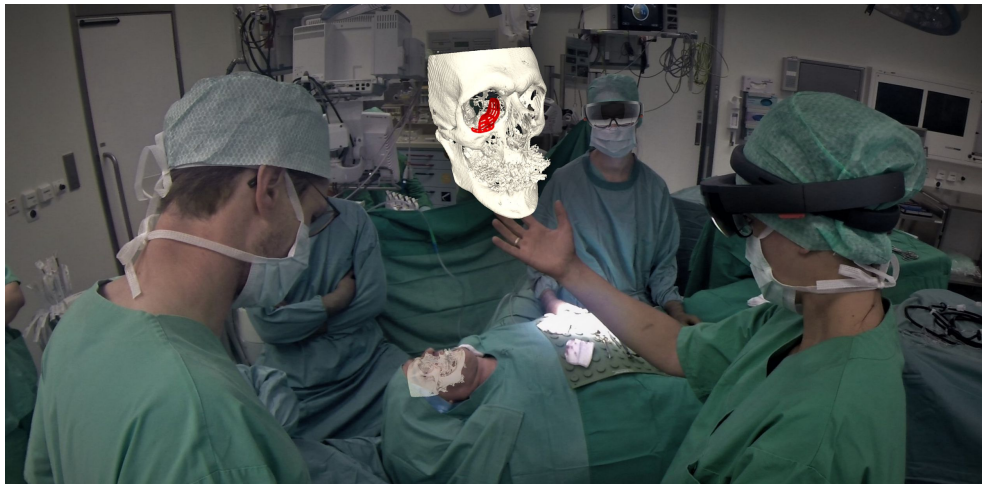
- Augmented reality (AR) can overcome current limitations in image-guided surgeries

Goal:

- Support maxillofacial surgeons during interventions with AR tools

Topics:

- Medical imaging & image analysis (e.g., segmentation)
- Medical data visualization for AR
- Development of AR applications
- Deep learning for medical AR



enFaced - Project Team & Collaborators

Jan Egger
Technical Lead

Jürgen Wallner
Medical Lead

Christina Schwarz-Gsaxner
PostDoc

Gijs Luijten
PhD Student

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Department for Oral- and Maxillofacial Surgery

Medical University of Graz

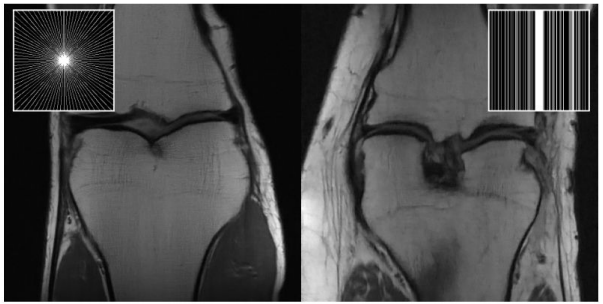
Institute of AI in Medicine

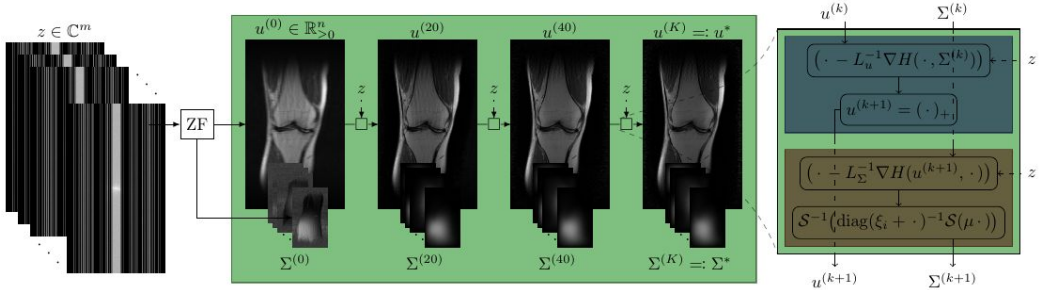
Universitätsmedizin Essen
Institut für KI in der Medizin (IKIM)

GE Healthcare

Stable Deep MRI with Generative Priors

- Learn parameters of a Gibbs prior with maximum likelihood
- Stable regularizer, agnostic to sampling patterns
- iPALM reconstruction





Martin Zach
PhD Student

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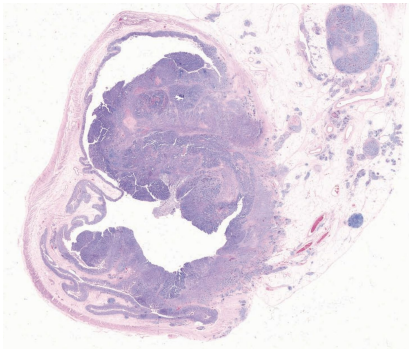
Histopathological Image Analysis

Motivation:

- Biobank Graz is one of the largest clinical biobanks in the world
- Large quantities of Histopathological Whole-Slide Images are available for analysis

Topics:

- Synthetic Image Generation
- Image Segmentation



Robert Harb
PhD Student

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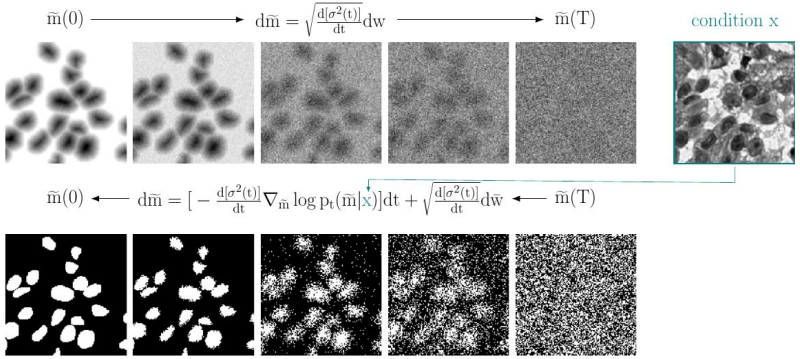
Diffusion Models for Image Segmentation

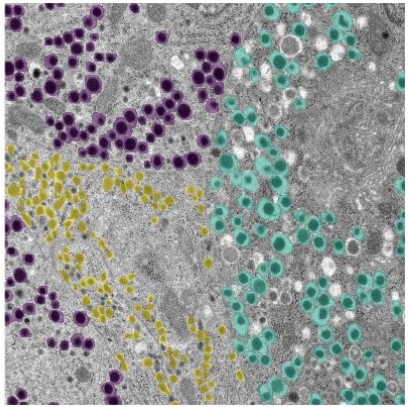
Motivation

- investigate the use of generative models for medical image segmentation

Topics

- binary/semantic segmentation with diffusion models/discriminative models
- Pancreatic data set of electron micrographs





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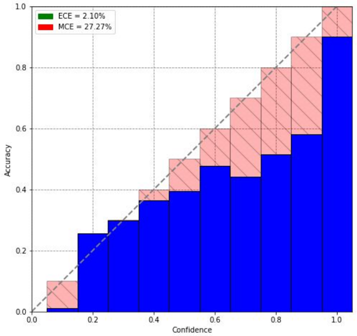
Fast Identification of Novelties

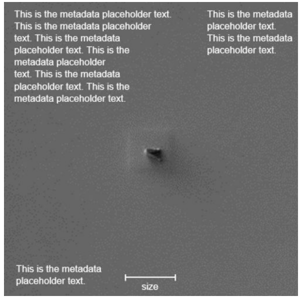


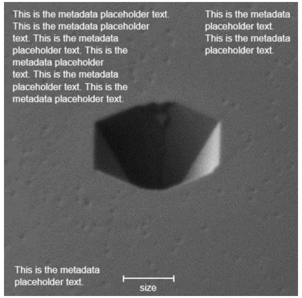
Motivation

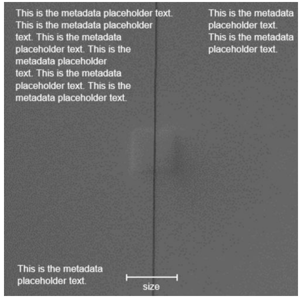
- Investigate methods to find novel classes
- Increase reliability of classifiers

Topics

- Energy Out-of-Distribution techniques
- Microscopic defects on silicon wafers







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Machine Learning and Representations

Marc Masana
PostDoc

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Machine Learning and Representations

Time-series (X-ray, ECG, ...)

- peak detection
- data generation
- classification

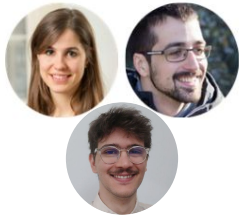
Image

- classification
- counting
- anomaly detection
- data generation
- labeling
- super-resolution

Video

- detection
- registration
- motion estimation

Bachelor thesis
Master thesis
Seminar project



Interests

- Diagnosis support
- Explainability
- Generalization
- Privacy preservation
- Novelty detection
- Data analysis

Mix and Match

- Machine learning
- Learning representations
- PyTorch

If anything caught your attention, send us an e-mail to organize a meeting.

Marc Masana
PostDoc

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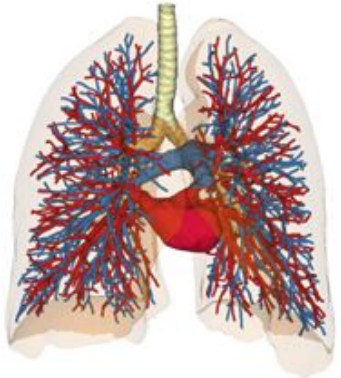
MUG-GUT Medical Image Analysis

Ass. Prof. Martin Urschler @ Institute for Medical Informatics, Statistics and Documentation & External Lecturer & ICG, TU Graz

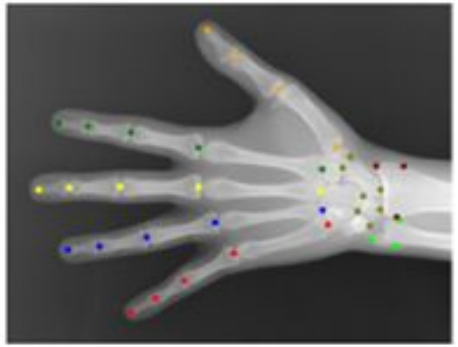
Group Interests in Model-based & Learning-based

- **Localization** of Anatomical Landmarks
- **Segmentation** of Radiological/Microscopy Images
- Statistical **Models** of Shape and Appearance
- **Vascular** Structure Enhancement & Classification

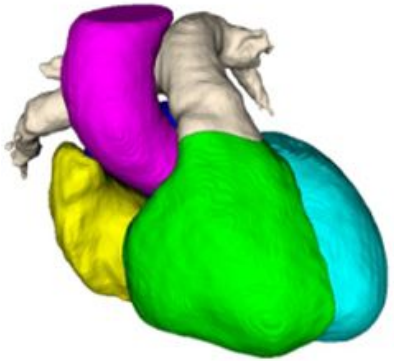
Examples:



Automated Artery Vein Separation from CT



Automated Localization of Bone Landmarks in Hand X-rays



Automated Multi-modality Whole Heart Segmentation from MRI or CT

MUG-GUT Open Topic

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Synthetization of Training Data for Vascular Segmentation

Motivation:

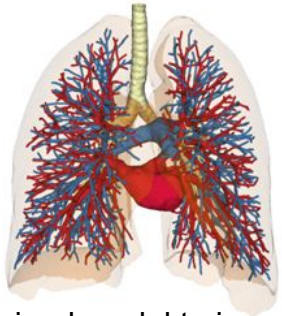
- Improve **small** vessel segmentation for computer-aided (early) diagnosis, e.g. for pulmonary hypertension
- Collaboration partner: Ludwig Boltzmann Institute for Lung Vascular Research Graz & Pulmonology @ MUG

Idea:

- Train vessel segmentation deep learning model based on a high-resolution synthetically generated data set

Synthesize tree-like structures randomly

Generate large amounts of **simulated** CT data



Use trained model to improve our Artery-Vein separation method

Computer vision for biomedical applications

Prof Horst Bischof

Franz Thaler

Uncertainty for 3D volume segmentation

Savinien Bonheur

Attention in neural architectures

Mateusz Koziński

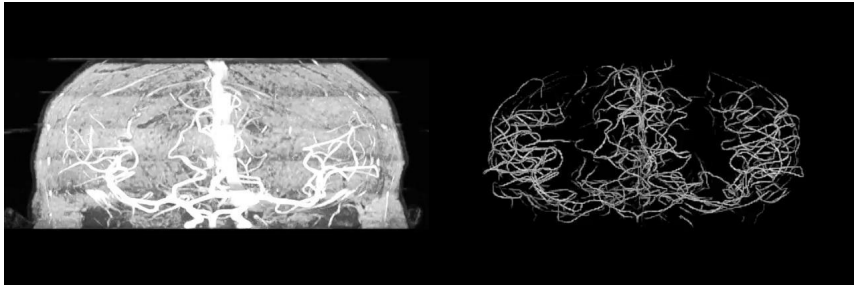
Structured object representations

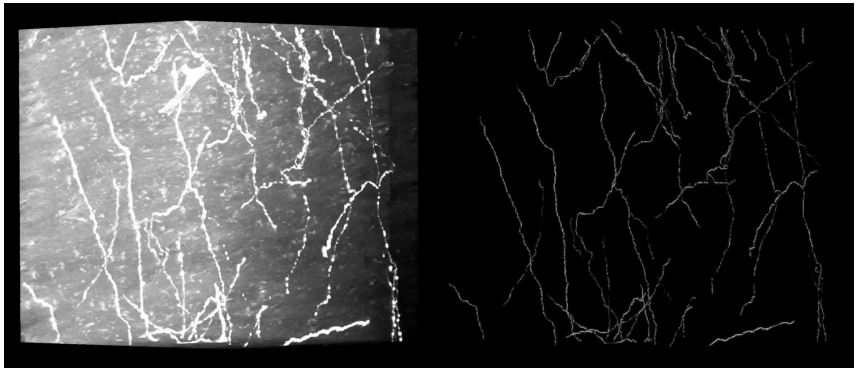
Network structure from image data

Deep networks are effective in reconstructing volumetric masks.

But for life-scientists and doctors, utility of such per-voxel masks is very limited.

- structure of underlying networks not represented
- Cannot be used to simulate or quantify their function



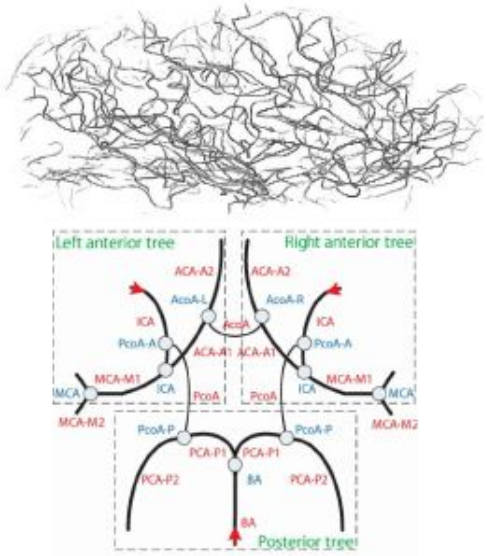


Computer vision for biomedical applications

There is a gap between the representations of network structures (neurons, blood vessels, roads) that deep learning provides (top image), and the representations that humans use (bottom image).

Goal

- Make AI produce structured, more useful representations of network structures
- Training deep nets to produce topologically correct delineartions
  - Persistent homology
  - connectivity -oriented loss functions
  - Loss functions robust to annotation in-accuracy
- Using priors, making deep architectures better suited to this task
  - Attention to thin structures
  - Efficient, GPU-enabled computations of “structural descriptors”
  - Shape grammars, shape priors
- Reconstructing structured models of the networks from 2D and 3D images
  - Graphs from images



Brain vasculature:
(top) according to a deep net
(bottom) according to a human

Possible Tasks:

- **New attention formulation for neurons and vascular structures**
- **connectivity -oriented technique for training**
- **Reconstruction of lung vasculature with reinforcement learning**

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Thank you & do not hesitate to contact us!